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NOTES AND COMMENTS.

The Geographical Congress.

THE Sixth Session of the International Geographical Congress was held in London from July 26 to August 3. Its proximity in date to the General Election was most unfortunate, as it kept away many men who might have helped with cash or in kind. Nevertheless, it certainly achieved a striking success, credit for which is mainly due to the two secretaries, Mr. J. Scott-Keltie and Dr. H. R. Mill, who represented respectively—and no better English representatives could have been found—the practical and commercial, and the abstract and scientific branches of geography. The Congress met twice a day for the reading of papers and discussions thereon. These meetings were held at the Imperial Institute, which is certainly admirably adapted to serve as the headquarters of such a congress, though it does not appear to be particularly cheap. Garden parties, evening fêtes and functions gave the geographers opportunity for social intercourse. The papers read were, as a rule, of a high order of merit, though a few trivial and some rubbishing productions, which certainly would never have been accepted for an ordinary meeting of the Geographical Society, were allowed to waste the time of the Congress. The discussions on Polar exploration and on the possibilities of African colonisation attracted most general attention. The former was introduced by papers by Professor Neumayer, Admiral Markham, General Greely, Herr S. A. Andrée and M. E. Payart. The latter was introduced by a symposium, to which contributions were made by Sir John Kirk, Captain Lugard, Count Pfeil, Mr. Stanley, Mr. Ravenstein, Mr. Silva White, M. Dècle, and Slatin Pasha. This was followed by a general discussion, which was an amusing game of cross questions and crooked answers. Mr. Stanley soon fell foul of the rest, owing to a different use of the word science and a different dividing line between common sense and scientific reasoning. Both sides seem to have meant exactly the same thing, but for a while the heat of the discussion was dangerously near tropical. Then, again,

Mr. Ravenstein and Mr. Silva White, impressed by the lessons taught by the meteorological records sent home, concluded that the climate is wholly unsuited for Europeans, and that no successful colonisation can be carried out. Their opinions were based on all kinds of barometric, thermometric, and hygrometric observations; but will-power was left out of account. And will-power counts for a great deal, especially when there is a Stanley in the matter. Mr. Silva White also declared that the African natives are quite unreliable, and all labour must either be forced or imported. Then the most valuable suggestion in M. Dècle's paper was the employment of a currency instead of barter goods in African commerce; this he thought might possibly, in the distant future, be managed to some extent. All this greatly irritated Mr. Stanley, who, having made up his mind that Equatorial Africa is to be colonised, is not going to be frightened by a bogie made up of meteorological tables. The talk about the impossibility of inducing the natives to work was a repetition of warnings which he had heard *ad nauseam* during the founding of the Congo Free State, but which he had, apparently, never expected to hear repeated, now that there are over 100,000 native porters at work on the Congo; while, as to the coinage, which M. Dècle seemed to regard as a matter for the distant future, there had been a paper currency in extensive use on the Congo for years. The discussion was mainly of interest from the contrast between the pessimistic predictions of the armchair geographers and the healthy contempt which Stanley expressed for difficulties and dangers. The last paper of any special general interest was Mr. Borchgrevink's account of his landing on the Antarctic Continent.

The only noticeable weakness in the Congress was in the attendance of British geographers. The foreigners came in great force, and the number included most of the leading geographers of the Continent. At the soirées the foreign guests almost swamped the English hosts. At the meetings this was still more noticeable. Prince Roland Bonaparte, for example, read a paper on the periodical variation of the French glaciers. These particular glaciers were first studied by Englishmen, and our countrymen have all along played a leading part in their exploration. We could easily pick out an English eleven which we would confidently back against any that could be formed in France for knowledge of the topography and geology of these French glaciers. There is, moreover, in England a most energetic school of glacialists, but we could not see in the room a single representative of this, or any of the many Englishmen to whom the glaciers of Dauphiné and Savoy are more familiar than the London parks. It was almost pathetic to see three such men as Penck, de Lapparent, and Murray presiding over, and to hear Naumann reading a masterly paper on the Fundamental Structural Lines of Asia Minor to, an audience of a dozen people, whose appreciation of the subject was such that Naumann had to spoil

his discourse by explaining the meaning of "fault" and other equally simple terms. The contrast between this and the Geological Congress held in London, 1888, was very striking. The explanation is, no doubt, partly due to the fact that in England physical geography is studied rather as a branch of geology than of geography, and the geologists were not tempted to abandon their field work and remain in London. At the Geological Congress the honorary president was Professor Huxley, whereas the office was filled on the present occasion by one king and four princes. The vice-presidents at the one were twenty-two of the leading geologists of the day, representing the twenty countries who sent delegates to the Congress. The first two pages of the list of honorary vice-presidents of the Geographical Congress looks like the record of the attendance at a levée. This probably gave English geologists, who are a democratic race, the impression that the Congress would be social rather than scientific, and thus they did not interrupt the season's field work and return to London to welcome their foreign colleagues. When they know the names of the men who came, and the character of the contributions laid before the meeting, we cannot but feel that many of them will deeply regret their absence.[1]

Deep-seated Water.

To bore for water at the celebrated falls of Trollhättan seems at first to be a carrying of coals to Newcastle. That it can hardly be so is shown by the fact that not only one bore-hole, but two or three, have been or are being sunk through the hard gneiss rocks at great expense. The history of these deep sinkings is one of much interest, both practical and scientific.

Twenty-seven years ago, in a paper on the geology of Spitzbergen, Nordenskiöld published some observations on the influence of cracks in masses of igneous rock. His ideas, subsequently developed and now put to a successful test, are, in a few simple words, somewhat as follows. In all large masses of igneous rock—or in such tracts of gneiss as extend over many hundred miles of Sweden—there are cracks and joints of varying extent and direction. Even if such cracks were at first quite insignificant they would slowly but inevitably be increased in size by a small but perpetually active set of forces. When, under the influence of cold, the rock contracts, the cracks are widened; thus a vertical crack (*c.c.*) becomes filled with water, sand, or mud. When, under the influence of heat, the rock expands, the crack, which would naturally be closed, remains wedged open by its new contents. Thus a pressure, minute but irresistible, is brought to bear on the rock-mass and forces it in a horizontal direction. And the process is repeated and repeated through the ages, as the cracks again widen and become filled with more water,

[1] We hope to publish an article on the work of the Congress next month.

sand, or mud (*c'.c'.*). Similarly, if there be slanting cracks, enclosing between them a wedge-shaped portion of rock (*a*), then with each contraction the wedge sinks, perhaps only a micromillimetre; but it sinks and sinks continually, and with each expansion the same lateral pressure forces the rock-masses in a horizontal direction.

But this system of forces can only act to a certain distance. Various theoretical considerations, such as the limit to which surface variations of temperature extend, and the resistance of the igneous rocks to a breaking strain, led Nordenskiöld to the conclusion that the vertical cracks could not penetrate further than from thirty to forty metres below sea-level; and that, at about that depth, there would be formed a series of horizontal cracks (*b.b.*), separating the upper moving portions of rock from the more deep-seated lower portion. If these conclusions were correct, it would follow that the water which slowly soaked down the vertical cracks would collect in and flow along the deep-lying horizontal cracks, and that there would be a large and constant source of fresh water at thirty to forty metres

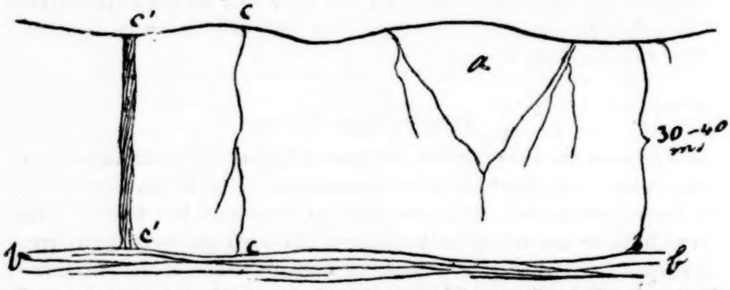

DIAGRAM EXPLAINING ORIGIN OF DEEP-SEATED WATER. Facsimile of a rough sketch by Baron Nordenskiöld.

below sea-level. With the aid of the diamond drill, this conclusion has lately been put to the test, and so far as the constant pressure of fresh water at the indicated depth can confirm it, the theory is fully confirmed.

The scientific consequences of this theory are evident and important. The recognition of large quantities of water included in and passing through the solid masses of gneiss, granite, and the like, is welcomed by those who ascribe to aqueous agencies the secondary changes that they believe to be still taking place in such rocks. Here, too, if one will but grant sufficient time, is suggested a potent cause of lateral pressure, of cleavage, and even of overthrusts and shearing.

But the confirmation of the theory has consequences no less important from the practical point of view. An entirely new water-supply is made available, and one can incur the considerable expense of the boring, confident that the money will not be wasted. Such a source of fresh water is of special value to lighthouse keepers on

waterless islands in precarious communication with the mainland. An instance is the boring on the Island of Arkö, one of the first that was made. There are now twelve such wells in Sweden, and there will soon be some in Finland. The fact that purity is a conspicuous character of the water thus derived, renders it of much value to the manufacturers of aërated waters; and it is this that explains the sinking of so many bore-holes at Trollhättan, otherwise so profusely supplied with water.

The Scientific Use of Shorthand.

The value of speed in writing is so obvious that it is strange that shorthand has been so little used by naturalists. Medical men seem more alive to its advantages, for there exists a "Society of Medical Phonographers." At its recent annual meeting its president, Dr. W. R. Gowers, F.R.S., who is an enthusiastic phonographer, delivered an address which so clearly states the merits of this system that we are glad to quote part of it.

Dr. Gowers stated that the object of the Society was "to promote the work of their profession, alike in medical science and its application in practice, by freeing it from one grave hindrance which the present has inherited from the past. Writing to-day is what it was when Caxton made it mechanical, with no attempt at improvement until the present generation. But now a method of writing is available in which simplicity of symbol corresponds to simplicity of sound, and which needs, with a greater average of legibility, only one-third of the time and less than one-third of the labour of ordinary writing.

"Science rests on observation, which without immediate record is of little value; not only is memory inadequate, but record at once reveals unsuspected imperfections in observation. Compared with longhand, shorthand permits, in a given time, twice the amount of record, while leaving twice the time for observation. The latter must be more minute and more precise to permit the fuller record, and the first effect of the use of shorthand is on the quality of work. The constant use reacts on the worker, and it is again found true that 'writing maketh an exact man.' In the daily work of the practitioner, which is peculiar in being a form of personal science—knowledge constantly increased by observation—record is most important. It changes vague impression into definite knowledge, and increases that ability which is so important to those who suffer. For most practitioners, record is practically impossible with longhand; it is possible for all with shorthand. The service of this, however small its influence may be thought, multiplied by numbers becomes incontestably important. The chief means adopted by the Society is the issue of medical literature in lithographed phonetic shorthand—a monthly periodical, and other publications. But the facility of writing and secure legibility which phonography affords,

have led to useful interchange of thought in other ways. It is important that the student should be familiar with shorthand before beginning professional studies, for it helps him in every form of work. It is much to be desired that shorthand should be made an extra subject in the entrance examination. It needs but a limited and short expenditure of time, and this is soon regained. It can, however, be quickly acquired at any age. It is now taught at many schools, but its subsequent use is not sufficiently encouraged. It may seem strange that the value of this mode of simple writing—quick, easy, and secure—should first be thus recognised by members of the medical profession; but it is noteworthy that in their hands its use will probably have most direct influence on the welfare of others."

POST-GRADUATE STUDY AND RESEARCH AT CAMBRIDGE.

THE new statutes respecting "research" degrees have been approved by the Senate of the University of Cambridge, and await only the confirmation of her Majesty in Council. In the probable event of the confirmation being obtained, the statutes will come into operation at once. The persons who are to be eligible must be twenty-one years of age at the time of their entry as "advanced students," and they must reside in the University for six terms. They must, in most cases, be graduates of a British or foreign University; but, in "exceptional cases," persons devoid of a diploma may be admitted on the presentation of evidence of special qualification. This special qualification is to be considered by the Degree Committee of the Special Board of Studies, with which the proposed course of advanced study or research is most nearly connected. All applicants must state the course or courses of advanced study or of research which they intend to pursue.

Here are the gates thrown widely open, and we have to look to the appointed gatekeepers that the unfit do not enter. It is clear enough that they will be thronged by persons seeking an easy degree for commercial purposes: and we must look to the "special committees" for a stern rejection of those who come for degrees rather than for work. It is most desirable that the large number of American graduates who go over to Germany for advanced work under new teachers should have the opportunity of coming to England: it is equally desirable that Scotch graduates should be able to enter English universities without having to pass again through an elementary mill; and the new statutes make this possible. But the host who have attended evening lectures and so forth have been clamouring for degrees; it is necessary that the strict letter of the statute "exceptional cases" should be maintained. After residence for two terms and pursuit of either "advanced study" or "research" the student, under the new regulations, may either compete for certain prescribed parts of the Tripos examinations, or may present the results

of his research to a special committee. When he has passed the Tripos, or been awarded a "Certificate of Research," and has kept six terms, he may proceed to the degree of B.A., and thereafter, like those who have become bachelors on the old regulations, he may proceed in due course to the higher degrees.

Anti-Darwinism.

Hope is beginning to flutter her wings again in the breasts of those who fear evolution. In the *Edinburgh Review* for July a thoughtful essayist makes notices of Bateson's "Variation" and Beddard's "Animal Colouration" the occasion of a crafty diatribe against Darwinism. He takes Bateson's arguments against continuous variation, and Beddard's exposure of the fantastic extremes to which some have pushed the doctrines of sexual selection, mimicry, and so forth, as evidence that at last the Darwinian stronghold is being taken, not by assault from without, but by defection of its scientific garrison. Now, it certainly is the case that many able naturalists at the present time are criticising the theories grouped round Natural Selection with great vigour. There is no likelihood that Darwinism will pass into an unassailable dogma, or that scientific men will have to subscribe to thirty-nine articles—even with the latitudinarian subscription acceptable in the English Church. But, apparently, it is necessary to repeat what Darwin and his illustrious disciples have stated, in season and out of season. Natural Selection, sexual selection, and all the various theories of the mechanism of evolution may turn out true or untrue. You may find among fifty competent naturalists fifty different views as to the extent of their operation. But evolution is true, and it was through Darwin's illuminating principle that evolution first became accepted as probable, and since has been accepted as inevitable by the great majority of those competent to judge. There may be what the Edinburgh Reviewer considers a revolt against Darwinism; but among famous naturalists of to-day you shall not find six (of whom we do not doubt the Edinburgh Reviewer to be one) who do not believe that the evolution of animals and plants has been placed beyond doubt, and that Darwin's work was the moving cause in the formation of this belief.

Mr. Grant Allen's Views.

In the *Fortnightly Review* for July, 1895, Mr. Grant Allen has an amazing contribution to Biology. He calls it a "flank movement against Weismann." Characteristically enough, he begins by a misstatement of Weismann's relation to the problems of heredity. He writes: "Before he (Weismann) intervened, we were all of us asking, 'How is transmission of acquired characters possible?' Weismann broke in with the prior question, 'Is transmission of acquired charac-

ters possible?'" Now it is a fact, notorious among biologists, that from the time of Darwin's provisional hypothesis of pangenesis until Weismann reopened the question, people were not asking "How is transmission of acquired characters possible?" Practically everyone who wrote with biological knowledge, and everyone who wrote without biological knowledge, assumed that acquired characters were transmitted, and troubled very little about the "how." The question Weismann raised was, not whether such transmission were possible, but whether or no it actually occurred. And whatever may come of Weismann's speculative views, the result of the controversy he raised has been that naturalists, instead of taking the inheritance of acquired characters for granted, are in two minds as to whether or no they are ever inherited. The majority of supposed cases has been disproved: there is little but the theoretical possibility left.

This, however, is a small matter, and Mr. Grant Allen deserves so well of the public for his admirable efforts and achievements in the popular presentation of science that we might have passed it by. But his own suggested contribution, offered as a "piece of bare philosophical thinking," is too primitive in its naked simplicity to avoid the interference of the scientific police. He suggests that the great mystery is not inheritance, but assimilation; not why John Evans begets little Jack Evans, but why the brown bread and beefsteak John Evans eats becomes turned into the flesh and body of John Evans. Certainly, the mystery of assimilation is great enough; though, perhaps, it is only more complicated, and not, in reality, deeper than the mystery involved in a crystal, growing in a mixed mother-liquid, attracting only particles like its own particles, and building these new particles into a predetermined geometrical structure. The mystery of inheritance is not the mystery of assimilation, but something more. An amœba feeds upon not-amœba: grows: divides: and there are two amœbæ. But a fertilised egg-cell feeds: grows: repeatedly divides, and the ultimate product may contain not a single cell like the original egg-cell, but forms a structure like that from which the egg-cell came. Here is a mystery within a mystery; the "me" feeding upon the "not-me" and growing, not into "me," but into my father. Mr. Grant Allen's apparent simplification of the problem is attained only by ignoring it.

Diphtheria Anti-Toxin.

At the recent meeting of the British Medical Association there took place an important discussion upon anti-toxin. It was remarkable how favourable were the reports by different specialists upon the new remedy. Dr. Sydney Martin explained in detail, with the aid of elaborate diagrams, the extent to which the anti-toxin had counteracted the effect of the diphtheria poison in a large number of cases

under his observation. Dr. Goodall, speaking from his experience of the clinical treatment under the Metropolitan Asylums Board of the severer forms of the disease, declared that only 22 per cent. had died under the new treatment, while 33 per cent. of those not treated with anti-toxin died. He thought, however, that the new treatment had little mitigating action upon concomitants of the disease, such as albuminaria and paralysis. Professor von Ranke, from Munich, and Professor Baginshi, from Berlin, were enthusiastic about the remedy. Even Mr. Lennox Browne, who has done his best to criticise the new treatment, stated that he was not an opponent of this method. Dr. Sims Woodhead said that the results of the new method were exceedingly favourable, more favourable than his bacteriological work led him to anticipate.

In fact, the general tone of the discussion was highly favourable to anti-toxin. Those singular critics of modern medicine who attack everything that is new, especially if it have the remotest connection with experiments upon living organisms, were conspicuous by their absence. Without doubt, however, they will be as active as ever in the evening newspapers and in circulars touting for subscriptions. If the great British public would only realise that medical men are actuated, not only by a genuine spirit of scientific truth, but by the knowledge that any delusive statistics will speedily be exposed by other medical men, they would be the less ready to listen to professional agitators. Whatever be the future of anti-toxin, it will depend, not upon the shrieks of agitators, but on the statistics of the authorities who employ it.

The Function of the Supra-renals.

The new physiology is proceeding with investigation of the "ductless" glands. Everyone knows that the thyroid has been shown to form a secretion which, carried by the blood all over the body, exercises the strongest effect upon the general vital activities of the body. It is concerned chiefly with the metabolism of the tissues. Where the thyroid is absent or diseased, degenerative changes rapidly ensue all over the body; and those changes may be arrested, or at least palliated, by injection of thyroid juices. Oliver and Schäfer have recently been investigating the action of the supra-renal capsules, organs whose function was completely unknown. They find that the supra-renal secretion produces striking physiological effects upon the muscular tissue generally, and especially upon that of the heart and arteries. Its action, apparently, is directly upon the muscular tissues: not mediately through the central nervous system. For they found that supra-renal extract had a direct effect upon the pulsation of an excised frog's heart. The same investigators have published a preliminary note (*Journal of Physiology*, July) upon the action of the pituitary body. They find that this mysterious

organ is a secretory organ, and that its action is to raise the blood-pressure.

THE MINUTE STRUCTURE OF SPLEEN.

IN the *Journal of Anatomy and Physiology* for July, 1895, Dr. E. W. Carlier describes a new method for investigating the structure of the spleen. Everyone knows that it is most difficult to obtain preparations of the spleen in which the minute structure is properly shown. In an animal that has died naturally, degenerative changes have begun in the spleen before preparations can be made; even in a freshly-killed animal the ordinary methods of "fixing" the protoplasm leaves much to be desired. Dr. Carlier proceeded by anæsthetising the animal deeply. The thorax was then rapidly opened, the apex of the heart removed, and a cannula fastened in the aorta. All the blood in the animal was then washed out by irrigation with normal saline solution, heated to the temperature of the animal's body. Immediately afterwards the saline solution was replaced by a warm solution of picro-corrosive sublimate. This penetrated into the smallest capillary of the animal's body and killed and fixed every cell in every organ in its normal condition.

THE CŒLOME AND NEPHRIDIA.

NOT long ago it was held that animals like *Hydra* possessed one cavity, the cœlenteron, communicating with the exterior by the mouth; while the *Cœlomata*, from the lowest worms up to man, were built on the plan of one hollow cylinder within another. The inner cylinder, opening at one end by the mouth, at the other by the anus, was the alimentary canal: the space between the alimentary canal and the body-wall was the cœlome. Subsequent research has modified the primitive simplicity of this view. The "cœlome" and "cœlomic spaces" are certainly not spaces of the same order in different sets of animals. Among the spaces we have first learned to separate "hæmatocœles," or blood-spaces, which are the most conspicuous cavities between the alimentary canal and the outer body-wall in many animals. But, more recently, distinctions are being made among cœlomic cavities that are not "hæmatocœles." In a valuable paper in the *Quarterly Journal of Microscopical Science* (June, 1895) Mr. Edwin S. Goodrich, one of Professor Ray Lankester's assistants at Oxford, puts together in a luminous fashion the results of later investigations. According to his excellent account, the cœlome is essentially a genital pouch, or set of pouches, hollowed out in the mesoblastic somites, and giving rise to the genital products. In simple cases, like *Amphioxus*, the most anterior of these pouches arise as direct outgrowths from the archenteron; but, however they arise, they most frequently fuse below the gut into a wide chamber lined by peritoneum and popularly known as the cœlome. From this chamber ducts grow outwards

towards the exterior, sometimes breaking directly through, sometimes meeting slight invaginations of the epiblast, sometimes fusing into longitudinal ducts. These centrifugally developing peritoneal ducts or funnels are the genital ducts and have nothing to do with true nephridia. They are to be found in the vast majority of cœlomates: in oligochætes, for instance, as the oviducts and vasa deferentia ; in vertebrates as the tubules of the pronephros.

True nephridial tubules are structures of another kind. Typically, they develop centripetally from outside inwards, and favour the suggestion that nephridia primitively were skin excretory organs. In actual development each arises as a single large cell, the interior of which develops a vacuole with a tuft of cilia—in fact, becomes a flame-cell, like those which flicker under the microscope when a live turbellarian is examined. From the flame-cell a tail of small cells grows towards the outside, and a duct is hollowed out in the thickness of these cells. Complications arise in two ways. In many cases, for instance in the common earthworm, these nephridia break into the cœlome, the flame-cell becoming the nephrostome, and the whole structure assuming a false analogy with a peritoneal funnel. Such a false analogy, Mr. Goodrich thinks, has led many investigators to derive peritoneal genital ducts from nephridia. The second complication occurs in such cases as the vertebrates, where the primitive peritoneal ducts assume excretory functions and become comparable with nephridia. Just as the nephridia in some cases have broken into the cœlome and so have posed as peritoneal funnels, so peritoneal funnels have occasionally assumed excretory functions and posed as nephridia. In the latter category are the pronephric tubules of vertebrates.

Mr. Beddard's Monograph.

Some time ago we received from the Clarendon Press a copy of Mr. Beddard's beautiful Monograph on the Oligochæta. We are glad to say that Professor Franz Vejdovsky has promised to write a detailed notice of the work for our columns, and our readers will thus have the opinion upon it of the greatest continental expert. As most naturalists are aware, Mr. Beddard has been working on Oligochætes for the last fifteen years, and has contributed largely to our knowledge of the group. The cost of the illustrations of the volume has been largely defrayed by the generosity of Mr. J. P. Gassiot, F.Z.S., who, at the suggestion of the Secretary of the Zoological Society, placed a sum of £100 at Mr. Beddard's disposal for the purpose. The Clarendon Press have published the volume in a sumptuous fashion ; and it forms a notable addition to the list of modern scientific monographs.

The first part (148 pages) deals with the anatomy of the group: there is not yet enough material for a systematic account of the

embryology that would contain any substantial addition to Vejdovsky's memoir. The last 500 pages are systematic.

It is interesting to notice, in reference to our last note, that Mr. Beddard takes a different view of the relation of the genital ducts to the nephridia from that of Mr. Goodrich. At one time he held that there was evidence for the derivation of a paired nephridial system, like that in *Lumbricus*, from a diffuse system, like that in *Megaloscolex*: later investigations by Spencer, Benham, himself, and especially by Vejdovsky, led him to believe that both diffuse and paired systems are equally ancient. Similarly, at one period of his investigations, he was inclined to abandon, as Mr. Goodrich does in his paper, the current view that the genital ducts were derived from nephridia. Latterly, however, he has returned to the generally-accepted view, and holds that the genital ducts certainly are modified nephridia. He thinks that the difficulty as to the coincidence of generative ducts and nephridia in a segment is cleared up by his discovery of multiple nephridial pores in *Octochætus* and other genera. Moreover, actually in the case of *Octochætus multiporus*, he was able to trace the development of the genital ducts from separated portions of the pronephridia.

Carbonic Oxide Poisoning.

In a recent number of the *Journal of Physiology* (July, 1895) Dr. John Haldane gives the results of experiments he has been making on the process of carbonic oxide poisoning. The experiments were made in connection with his investigation, now in process, into the nature and action of the poisonous gases in the air of coal mines. He concludes that the poisonous action of carbonic acid diminishes as the oxygen tension increases, and *vice versâ*. With an oxygen tension of two atmospheres the poisonous action was abolished in the case of mice. The disappearance of this poisonous action is due to the fact that at high oxygen tensions the animals can dispense entirely with the oxygen-carrying function of hæmoglobin. The poisonous action of carbonic acid is entirely due to its power of combining with the hæmoglobin of the red corpuscles, and so putting them out of action as oxygen-carriers.

This adds another to the remarkable series of results Dr. Haldane has obtained. He has already shown that carbonic acid and the organic substances in foul air are not the direct poisons they have been supposed, but that it is the diminution of oxygen-tension, usually associated with their presence, that does the damage. Carbonic oxide has been regarded still more as a direct poison, and the discovery that an increase of oxygen restrains and finally overcomes the disastrous results of its presence has an important practical as well as theoretical bearing. The generation of oxygen, rather than attempts at ventilation, would seem to be the new method for protecting dangerous mines.

Adders and Their Young.

Readers of Natural Science may remember a note of ours early in the season respecting the alleged habit of young adders, that of taking refuge in the mouth of their mothers. At the time we were, and still are, sceptical as to the habit. But it must be remembered that a large body of tradition and popular belief exists in favour of it, and that more than one naturalist believes in it. There are many districts in Britain where adders are abundant; for instance, in many parts of the New Forest, in Devon and Cornwall, in Wales, and in the Scotch Highlands. Adders should have their young about them all through August in England, and well on to October in the Highlands. Every naturalist should be on the outlook for them. They are to be found most easily by stealing along hedgerows and ditches in sunny places. Quietness is necessary, as they are easily disturbed and conceal themselves rapidly. The best way to catch them is to pin them between the prongs of a forked stick, and then, with a pair of forceps or small tongs, to place them in a tin case. If it should fall to the lot of a reader to see anything like the supposed habit, he should use every endeavour to secure the specimen. Let it be remembered that it is now too late for verbal testimony—there is enough of that and to spare. The adder must be killed, preserved in spirit, and opened by a skilled naturalist in the presence of witnesses. As we have already said, the Editor of Natural Science will be more than willing to receive any such specimen, and place it in the best hands for examination, giving all due credit to the owner of the specimen.

Determination of Sex.

M. de Kerhervé has communicated to the *Mémoires de la Société Zoologique* (viii., 2) a further account of his studies upon the reproduction of Entomostraca. He found that with various species of *Daphnia* kept in captivity, it was easy to provoke the appearance of males among the broods. As long as the conditions of temperature and nutrition were favourable, the daphnids reproduced parthenogenetically and gave rise to females only. The rate of reproduction varied directly with the nutrition. With well-fed daphnids reproduction was so rapid that three or even four generations might be seen lying one within the other, a veritable picture of the old idea of evolution. While the young were yet within the brood-pouch of the mother they had given rise to new generations of young within their own brood-pouches, while in these again the young might be detected. But when the animals were subjected to a lower temperature and to an impoverished food-supply, males were produced in excess of females.

M. de Kerhervé regards these interesting, although not quite novel, results as being quite opposed to Weismann's views. He

thinks that it is a clear case of the direct effect of the agency of external circumstances to the exclusion of internal causes. It is, however, obvious that even here internal causes are at work, although the direct stimulus comes from without. M. de Kerhervé himself shows that, in the case of different species, the same external influences operated differently: one of the factors is what may be called the specific constitution.

The Fossil Birds of La Plata.

It may be remembered that in his account of the La Plata Museum, in Natural Science at the beginning of last year, Mr. Lydekker gave a brief description of the gigantic fossil birds of Patagonia, which at that time were only imperfectly known through the writings of Ameghino, Moreno, and Mercerat. Our knowledge of these remarkable fossils has lately been greatly increased by a paper of Ameghino's descriptive of a large series of bones, including all the important parts of the skeleton (except the sternum) of several species of the remarkable genus *Phororhacos*. From this description it appears that these birds, unlike the recent Ratitæ, possessed heads very large in proportion to the rest of the body. In the larger species of *Phororhacos*, *P. longissimus*, the skull is said to have been upwards of two feet in length, and about ten inches high at the hinder end of the beak. This latter was laterally compressed something like that of the Puffin, and was hooked at the tip. The mandible, unlike that of nearly all recent birds, turned up at the anterior end. It was originally stated that the jaws bore teeth, but this is now found to be incorrect.

The wing-bones were of the usual form, but proportionately very small, so that it seems improbable that these birds were capable of flight, though, no doubt, the wings were employed to aid in running or, perhaps, in swimming. The ulna bears strongly marked impressions of the insertions of the quills of the secondaries.

The bones of the hind limb of one of the smaller species were together about three feet in length; the toes, of which there were four, were armed with strong hooked claws. The posterior vertebræ of the tail did not unite to form a "pygostyle" for the support of the tail feathers as in the Carinatæ, but remained separate from one another, and are said to have been perforated by a notochordal canal.

Besides *Phororhacos*, several other genera are described, some differing so widely that they will doubtless eventually be placed in separate families. The name "Stereornithes" has been adopted for these large birds from the Eocene (?) of South America, and it has been suggested that *Gastornis* and *Dasornis* from the Lower Tertiary deposits of England and France may be representatives of the same group, which has been regarded as the ancestral stock of the living Ratitæ. It seems quite as likely that the Stereornithes are a group of birds not necessarily closely related to one another, the members

of which have, to a greater or less degree, lost their power of flight, owing to the influence of their environment.

Botany and the Science and Art Department.

In the August number of Natural Science we referred to a complaint against the method of testing candidates for the South Kensington Examinations in practical botany in the elementary and more especially in the advanced stage. We are inclined to take a wider view of the question and ask if the Department has selected the best means of awarding the grant placed by Government at its disposal for the encouragement and aid of scientific teaching.

Without a doubt there are numbers of men and women, younger and older, who, while anxious to get a knowledge of the various sciences, are quite unable to pay fees which would adequately remunerate any teacher capable of acting as a trustworthy guide. In some cases the student is anxious only to improve his own position by accumulating the certificates of the Department; he may want to earn the right to become in turn a teacher of the subject. The elementary school teacher is a case in point. But there are many who take up a science purely from love of it and a desire to know something about the rocks and stones, the plants and animals, which are to be found outside the busy town in which they are doomed to spend the best part of their lives. And these are at least as deserving of encouragement. Given, then, that there are students asking for knowledge, and on the other hand a Government Department charged with the duty of helping them to that knowledge, the question arises as to whether the means at present adopted is the best and only means.

Quite recently a new step was taken by Government in appointing a number of inspectors, who were to visit the different classes and, presumably, to see that proper instruction was given. But, if the inspectors' report counts for nothing in the partition of the grant, and the latter still depends solely on examination results, why go to the additional expense of an increased staff? Obviously, if the instruction given falls below the standard, the students will fail in their examination, and no other test is needed. Perhaps examinations are a necessary evil; but it strikes one that some account might also be taken of work actually done by the students, especially of practical work, which sadly needs encouragement, though it is far and away the most valuable. Let the Department provide note-books in which the student shall each evening enter the result or some account of his work on actual specimens with illustrative sketches. These could be looked through and reported on by the inspector, and count towards the earning of a grant in which a final examination at the end of the course might, if necessary, share.

Failing to pass, or inability to sit for, the examination should not

necessarily preclude payment. At the end of May, when many of the examinations are held, holidays are beginning in large firms, and sitting for the examination may mean the loss or spoiling of the hard-earned yearly fortnight's rest from business. Under present conditions either student or teacher is the loser; generally the unfortunate teacher. The Department, in their syllabus, are emphatic, and rightly so, in insisting on a practical knowledge, but, at the same time, are in many points extremely dilatory in its practical encouragement. Classes must be held between October and May, but the best time for practical work, at any rate in geology and botany, is between May and October. As our correspondent asks, could not some encouragement be given to field classes in the summer months? Doubtless they are held here and there by enterprising teachers, but students are so generally well aware that they "don't count," that they are not nearly so well supported as they would be were they a recognised part of the course.

In the *Memoirs and Proceedings of the Manchester Literary and Philosophical Society* (ser. 4, vol. ix., p. 179) Mr. Thomas Hick describes the internal structure of *Calamite* leaves. While the anatomy of the root, stem, and fruit of these old-world Equisetums has been worked out in considerable detail, little or nothing was known of that of the leaf. Hence Mr. Hick's memoir forms a valuable supplement to our previous knowledge of these fossil plants. The leaves examined were very small, being those borne by the delicate ultimate branchlets, and recalling in appearance and habit those of a well-grown Chara. The observations recorded show that they were simple uni-nerved structures, with a central, delicate, vascular bundle arranged on the collateral type, and surrounded by a cortex in which can be distinguished an inner layer of long cells with black contents continuous with a similar layer in the twig, and styled "melasmatic" tissue, and an outer, thicker layer of assimilating tissue. Surrounding the whole is a single-layered epidermis, consisting of cells of uniform size, with thickened outer walls. A transverse section of a leaf recalls in general outline that of a pine-needle, being rounded on the under surface and more or less flattened above, with a large median protrusion above the vascular strand.

We print this month an article by Mr. R. D. Oldham, of the Indian Geological Survey, upon the alleged occurrence of traces of Miocene man in Burma. In common with other journals, we inserted a notice of this supposed discovery. The flakes in question showed such indisputable evidence of human workmanship that, had the claim that they had been collected from actual Miocene deposits been verified, we must have accepted this date for the age of man. We are glad to be able to publish such an authoritative correction of this report as that by Mr. Oldham.

I.

Natural Science in Newcastle.[1]

IT will be my purpose to bring before you a brief history of the progress of biology in Newcastle, with especial reference to its museums; and it would be the neglect of an obvious duty if, as introductory to this, reference were not made to the little band of able naturalists of a past generation, since to them was due the origin of the two societies still working here, the "Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne," and the "Tyneside Naturalists' Field Club."

About the year 1829 certain scientific men, among whom were Joshua Alder, William Hutton, Thomas, John, and Albany Hancock, William Hewetson, George Waites, George Burnett, William Robertson, and George Abbs, conceived the idea that it would be at once pleasant, profitable, and advantageous in all ways if they should meet together frequently for the purpose of conversation and discussion on the several branches of natural history, to the study of which they were devoting their time. To this end they instituted "Wednesday evening meetings," for such was the designation by which these friendly gatherings were known. They were held fortnightly, at seven o'clock, at the houses of the members in turn. All unnecessary expense was avoided; a simple tea was given by the host; while two things were distinctly forbidden—discussion on political topics and the use of alcohol. Any discovery made by a member was communicated, specimens of interest were exhibited, and the conversation was, for the most part, confined to scientific subjects. The meeting usually broke up about midnight. Naturalists in neighbouring places, in passing through Newcastle, were frequently invited guests, and as such a guest I was, when a young man, once present and enjoyed a delightful evening. Before the party separated the next house of meeting was fixed, and invitations were then given to those who did not themselves entertain; but it was understood that any member was at liberty to bring with him any naturalist who was temporarily in the town. Joseph Blacklock, R. S. Bowman, and Dr. Embleton became members at a later period, and the last-named

[1] From Canon Norman's Presidential Address to the Museums' Association at Newcastle.

venerable physician, known, not only by his writings, but also by the fact that long years ago he assisted Albany Hancock in his earlier anatomical investigations,[1] is the only still surviving member. Mr. R. G. Green and our excellent curator, Mr. R. Howse, were, however, frequently invited guests. It is to Mr. Howse that I am indebted for most of these particulars respecting this Club. He tells me that he was a regularly invited guest from the year 1846,[2] and that in 1857 he attended a meeting held at Mr. Blacklock's lodgings, at the Barras Bridge, to meet an old friend, William Kennett Loftus, who had just returned from his Assyrian expedition and then visited Newcastle for the last time. This was the latest occasion on which he attended, but the Wednesday evening meetings seem to have lingered on for a year or two more and then gently expired, having fulfilled their mission, about 1860. It has seemed especially desirable to call the attention of the members of the "Museums Association" to these "Wednesday evening meetings" and to the stimulus they were the means of giving to the study of natural history here; since the establishment of such friendly social gatherings in other towns might be productive of much good in bringing men of kindred tastes into close association and creating an impetus towards active work.

It will be noticed that the members of these meetings for the most part became eminent in the branches of science to which each more especially devoted himself, while at the same time they were continually gaining knowledge, and more extended range of interest, from the association with those who were pursuing different paths through the vast fields of Natural Science.

TYNESIDE NATURALISTS' FIELD CLUB.

It will be convenient now to refer to the Tyneside Naturalists' Field Club.

The "Berwickshire Naturalists' Field Club," still in a flourishing condition, has the honour of being the oldest field club in the kingdom; and the Tyneside club is the next oldest, and may in some measure be considered an offspring of that of Berwickshire, since Ralph Carr, Esq., of Dunstan Hill, who was a member of the Berwickshire Club, took a very active part in starting it, and was its first president.

The first meeting of the Tyneside Naturalists' Field Club was held on the 25th day of April, 1846, in the room of the Natural History Society, the Rev. R. C. Coxe, vicar of Newcastle, being in the chair; at this meeting the rules were drawn up. At the ensuing meeting, held on May 11, it was resolved that the Club, besides holding

[1] *e.g.*, A. Hancock and D. Embleton, "On the Anatomy of Eolis, a genus of Molluscs of the Order Nudibranchiata." *Ann. and Mag. Nat. Hist.*, vol. xv., 1845, and ser. 2, vol. i., 1845, and vol. ii., 1849.

[2] I may mention that it was in the following year, 1847, that Mr. Howse published his first paper known to me, in *Ann. and Mag. Nat. Hist.*, vol. xix., on the Dogger Bank "Fusi," and their ova-capsules and embryos, illustrated by an admirable plate.

field meetings, "undertakes the formation and publication of correct lists of the various natural productions of the counties of Northumberland and Durham"; and also "that a succinct account of the geology of the district be prepared." It was further resolved that "local collections be formed and placed, with the consent of the Natural History Society, in the Newcastle Museum." Sub-committees to carry out these views were appointed, and included many still honoured names; in various branches of Zoology, John and Albany Hancock, R. E. Bewick, M. J. T. Sidney, J. H. Fryer, Joshua Alder; in Entomology, James Hardy, J. T. Bold, John Hancock, and Thomas Pigg, junior; in Botany, Messrs. Thornhill, Thompson, and J. Storey, and the Rev. J. T. Bigge; in Geology, Messrs. Hutton, Fryer, Sopwith, Loftus, and King.

From the first the *Transactions of the Tyneside Naturalists' Field Club* took a high place in Natural History literature, and this continued during the lives of the able naturalists who were its parents, and I well recollect Dr. John E. Gray, a most competent judge, speaking to me of those *Transactions* as the most valuable provincial Natural History publication in the kingdom. Our naturalists now are fewer in number, and neither the Club nor its publications are in the flourishing condition they once were. Let us hope that a time of revival will come. There have been published six volumes of the original *Transactions of the Tyneside Naturalists' Field Club*, and eleven of the new series, which dates from 1865, from which period the joint papers of "Natural History Society" and of the "Tyneside Naturalists' Field Club" have been issued under the title *Natural History Transactions of Northumberland and Durham.*

[As the Newcastle Museum of Natural History was described in the August number of NATURAL SCIENCE by Mr. Alexander Meek, it is not thought necessary to include here the section of the address devoted to this institution.—ED., NAT. SCI.]

THE MUSEUM OF ANTIQUITIES.

The Museum of the Newcastle Society of Antiquities is nearly coëval with the present century. Its nucleus consists of the antiquarian portion of the Allan Museum handed over to the Society of Antiquaries by the Literary and Philosophical Society, who had come into its possession, and who retained for a time the zoological portion in their own hands. Round this nucleus were gathered the results of various excavations at Borcovicus, Habitancum, and other Roman stations, also some interesting Saxon stones, and the fragments of the remarkable Rothbury Cross. With the exceptions above mentioned, the treasures of the museum have been gathered piecemeal through the generosity of individual donors, and there has been no considerable purchase from any other collection.

The museum is, on the whole, richer in remains of the Roman than of any other period. There is, however, a large collection of

coins (not exhibited to the general public), including an almost complete series of the Stycas of the Anglian Kings of Northumbria.

A portion of the museum still remains in its old quarters at the Norman Keep (where the Society regularly holds its meetings); but the larger part, including the almost unique collection of Roman altars, is now deposited in the building known as the Black Gate. This interesting edifice, formerly the principal gateway of the castle, was rescued from destruction and thoroughly repaired by the Society of Antiquaries, and was opened as a museum on the occasion of the visit of the Archæological Institute to Newcastle in the year 1884. It is important to observe that the museum is now in course of re-arrangement, a process which, it is hoped, will be completed by the end of the current year.

The general plan of the collections when thus re-arranged will be this:—

1st Floor.—Roman inscribed stones.

2nd Floor.—Prehistoric Roman and Mediæval antiquities.

3rd Floor.—Collections illustrating the local history of Newcastle-upon-Tyne.

The curators of the museum are Mr. Charles James Spence, of North Shields, and Mr. Richard Oliver Heslop, of Corbridge.

MUSEUM OF THE UNIVERSITY OF DURHAM COLLEGE OF MEDICINE.

The University of Durham College of Medicine, Newcastle-upon-Tyne, was founded in the year 1851, and admitted into connection with the University of Durham in 1852.

The museums of comparative anatomy and pathology, of materia medica and hygiene are open to students.

A catalogue has been issued intended to be used in illustration of the text-book descriptions of diseased structures.

The number of students who attended the college during the academic year 1894–95 was 220.

A. M. NORMAN.

II.

The Geology of Ipswich and its Neighbourhood.

IT is many years since the British Association met in the Eastern Counties, and a good deal has recently been learnt about East Anglian geology. In fact, since 1868 many of the principal memoirs have appeared, including the classical ones of Messrs. Wood and Harmer (6), and of Professor Prestwich (2); the officers of the Geological Survey also have since that date commenced and completed an examination of the whole district (3, 4, 5). It may be useful under these circumstances to devote a few pages to a sketch of the geology of the region around Ipswich; for the British Association's excursions form an important part of the scientific work of the geological section, and in this country there are few other opportunities for British and foreign geologists to meet and compare notes in the field.

The first thing that will strike a visitor traversing East Anglia is that it is essentially a region of low plateaus, cut into by wide, shallow river valleys. This flatness of the country and absence of any dominant elevations may not be conspicuous from the rail, which nearly everywhere keeps to the valleys, but, nevertheless, it is a characteristic feature. The geology of these table-lands is usually very monotonous, most of the interest being concentrated in the valleys and cliffs, which cut through the glacial deposits to the fossiliferous Tertiary beds below. Thus it will be found that geologists describing this country tend to follow the valleys, though the deposits described may be totally unconnected with the river-systems.

The most ancient rock visible at the surface within twenty miles of Ipswich is no older than the Upper Chalk, but it may be interesting to mention that a boring at Harwich penetrated to the Palæozoic rocks, and further information on the Palæozoic floor will probably be communicated to the meeting. In the boring at Harwich the Chalk was 890 ft. thick, then followed 61 ft. of Greensand and Gault, which rested on a hard slaty rock, apparently of Carboniferous age. Thus the Upper Cretaceous lies directly on Palæozoic rocks, the whole of the other Secondary strata being absent.

In the immediate neighbourhood of Ipswich the Upper Chalk is reached in the lower part of the valleys at several points. It is succeeded by a thin representative of the Thanet Sands, here, unfortunately, seldom yielding determinable fossils, though casts of *Nucula* and *Cardium* are in the Ipswich Museum. Next occur the current-bedded and variable Woolwich and Reading series, consisting here mainly of sands, but with occasional lenticular masses of red-mottled clay. These have yielded no fossils near Ipswich.

The lower part of the London Clay is well seen at various places, particularly in the sea-cliffs at Felixstowe and Harwich, where it yields remains of turtles, fish, and pyritised plants. An enormous quantity of London Clay fossils is also obtained from the gravelly base of the Crag, but these are principally phosphatised bones and teeth of sharks. It is probable that short excursions during the meeting of the Association will give an opportunity for an examination of all the Eocene deposits represented near Ipswich.

There is little doubt that, for the majority of visitors, the geological interest centres around the fine series of Pliocene and Pleistocene deposits represented in the Eastern Counties. The succession is apparently more complete than anywhere else in Northern Europe, and we must travel as far as Italy and Sicily before meeting with so continuous a series of strata belonging to these periods, and so large a variety of fossils.

Between the lowest Pliocene deposits and the London Clay there is a marked break and unconformity, so that the gravelly base of the Pliocene is full, as already stated, of derived Eocene fossils. Of these a good series will be seen in the Ipswich Museum; and it will be noticed also that mixed with them occur some derivative fossils of very early Pliocene date. True Miocene fossils are apparently missing; though a few possibly derived from Oligocene beds do occur. This Pliocene basement bed is, or rather was, extensively worked for phosphatic nodules, and though many of the nodules are inorganic, there is so large a mixture of bones and teeth as to make the "nodule bed," miscalled a "coprolite bed," one of the most celebrated horizons in Britain for Tertiary fossils. The fossils consist to a large extent of bones or teeth of whales, dolphins, and sharks; though mixed with these are many teeth of land animals, such as the mastodon, rhinoceros, tapir, pig, and deer. It is unfortunate that the competition of cheaper foreign phosphates has rendered it impossible any longer to work these pits, but a few sections will probably still be visible, though it is difficult now to obtain any mammalian remains.

The oldest undisturbed Pliocene deposit yet found in the Eastern Counties is a soft limestone composed mainly of shells and bryozoa. This is the so-called Coralline Crag, which has yielded a most prolific Older Pliocene marine fauna, showing affinities with that of the existing Mediterranean and a similar climate. Above the Coral-

line Crag, and resting unconformably on it or on the London Clay, follow false-bedded marine sands, with fossils pointing to shallow water and to a sea getting colder and colder as time goes on. This gradual climatic change is well exhibited by the various sections around Ipswich. At Walton, for instance, the oldest part of the Red Crag contains fossils indicating a climate not greatly colder than that of the Coralline Crag period. At Butley the newer part of the Red Crag yields more boreal species; while at Chillesford the arctic mollusca form a still larger proportion of the whole. Near Cromer, on the Norfolk coast —which will be visited by one of the excursions—a later stage, the Weybourn Crag, is represented. This crag, though still full of characteristic Pliocene mollusca, yields a very large percentage of arctic forms. The gradual refrigeration of the climate in the course of time, the disappearance of the southern and extinct forms, and the incoming of the Arctic species, is well exhibited in a table of the marine mollusca drawn up some years since, and here reproduced:—

	Total.	Arctic.	Mediterranean.	Extinct.
Weybourn Crag	53	9	0	5
Chillesford Crag	90	7	2	14
Fluvio-marine Crag	112	9	7	18
Red Crag of Boyton, etc.	199	13	23	55
Red Crag of Walton	148	2	22	50
Coralline Crag	420	1 (?)	75	169

The evidence yielded by the marine fauna of the Pliocene period does not tally, however, with that of the land and freshwater species. It is often stated that after the gradual refrigeration of the climate there was again a warm period, before the commencement of the actual glaciation of East Anglia, and that this mild interval is represented by the Cromer Forest-bed with its temperate fauna and flora. Of this Pliocene alternation of climates I do not think there is any real evidence. The Newer Pliocene marine fauna, from whatever horizon it is obtained, is always somewhat arctic, the whales and the few marine mollusca of the Cromer Forest-bed being just as boreal as those of the Crag below. The Pliocene land animals and plants, on the other hand, from every horizon are, with one or two exceptions, temperate species. The necessity, so often noticed by geologists, for two parallel classifications for the marine and for the land faunas, is nowhere more marked than in the Newer Pliocene period, and in describing the deposits I have been obliged to keep the parallel faunas quite distinct (4).

The reason for this singular discordance between the apparent climatic conditions as shown by the marine animals and that evidenced by the land and freshwater fauna and flora is probably very simple and due to a slight change in the physical geography. During the deposition of the Coralline Crag the sea was open to the south, and everything points to a genial climate. But when the shoaler water Newer Pliocene was being deposited, land connected England with

France, so that southern land animals could cross freely. The same land barrier, however, isolated the North Sea, so that it was only open towards the north, and not only was the sea therefore colder than the air, but only northern species could enter this enclosed area, and any southern forms happening to die out could not be replaced. For this reason it is probable that the temperature of our Newer Pliocene sea may not have been quite so low as the marine fossils alone would appear to indicate.

Though the Cromer Forest-bed is not visible in the immediate neighbourhood of Ipswich, yet as it is intended so to arrange the excursions as to give an opportunity of examining all the Pliocene deposits, a short description of this stage may be useful (3).

The Cromer Forest-bed consists of a series of land, freshwater, and estuarine deposits formed in the delta of a large river, which seems to have been a continuation of the Rhine across the shallow bed of the North Sea. Though thin, these deposits are of great interest, owing to the prolific fauna and flora which they contain, and to the evidence which they yield as to climatic conditions immediately previous to the Glacial Epoch. The plants of the Forest-bed, and also to a large extent the invertebrate fauna, show a close approximation to the present inhabitants of our Eastern Counties; for though the occurrence of such species as the spruce fir, the water-chestnut, and the extinct *Paradoxocarpus carinatus* would give a peculiar character to the flora in the eyes of a botanist, yet any ordinary observer would only notice the forests of oak, Scotch pine, beech, birch, elm, hazel, hornbeam, and cornel. The lakes were full of yellow water-lily, water-crowfoot, and various existing species of pondweeds, their shores were occupied by thickets of alder and willow, of osmunda, or dense growth of reeds and sedges. Amid these the few and rare extinct plants might easily be overlooked.

If, however, while wandering through these Pliocene woods or along the shores of the Pliocene broads we were to meet with any of the larger mammals, this illusion would be entirely swept away. Nearly all the larger species are now entirely extinct or are extinct in Europe. Among the most abundant were three species of elephant, two of rhinoceros, a hippopotamus, two horses, and various peculiar deer. The carnivora included bears, hyænas, the machærodus, and the glutton. Among the rodents was a gigantic beaver. A few of these large mammals survived down to Pleistocene times, and some are still living, but most of them appear to have been exterminated during the first glaciation.

The stages immediately succeeding the Forest-bed are still, notwithstanding all our efforts, most imperfectly understood. Marine sands overlying the Forest-bed near Cromer contain in one place arctic shells, in another a bed of oysters, which cannot stand intense cold. Between these marine sands and the earliest Boulder Clay occur patches of laminated clay and loam, often very suggestive of

stratified glacier mud, containing an intensely arctic flora. There are no trees, only dwarf willows, birches, and herbaceous plants, such as point to a temperature fully twenty degrees lower than at present.

It has already been mentioned that glacial deposits occupy the surface over great part of East Anglia. The classification and correlation of these is extremely difficult; but so far as can be made out, the oldest of them are only feebly represented away from the Norfolk coast, in the region where the arctic plant-bed above mentioned has been found. In the neighbourhood of Ipswich the most striking representative of the Glacial Epoch consists in the great sheet of unstratified Boulder Clay which extends southward nearly to the Thames and northward into Lincolnshire. The mode of origin of this sheet of morainic material is not yet clearly understood, for it is totally unlike anything now being formed by alpine glaciers or deposited in arctic seas. We should not forget, however, that an ice-sheet flowing over a flat country, where the average temperature is near the freezing point, is subjected to conditions entirely unlike those of an alpine glacier flowing down a steep valley into a temperate climate. It is, therefore, only with the ice-sheets of the Arctic and Antarctic regions, or with the wide glaciers of Alaska, that we can profitably compare the ancient glaciation of the North Sea basin. Space will not permit us here to discuss this question, but attention may be drawn to the address by Professor T. C. Chamberlin, entitled "Recent Glacial Studies in Greenland" (1). The facts there brought forward throw a flood of light on some of the obscure points in the glaciation of East Anglia, and anyone studying the intricate glacial deposits of the Norfolk coast should read Professor Chamberlin's description and examine his photographs.

One very puzzling peculiarity of the East Anglian Boulder Clays is likely to come forward prominently at the Ipswich meeting. This is the strange mixture of erratics from different districts. Blocks from Yorkshire, and perhaps Scotland, are mingled promiscuously with others from the islands in the Baltic or from the coast of Norway. There has been much discussion as to the meaning of this mixture; but, from the fact that many of the boulders are worm-eaten beach stones, subsequently glaciated, it is probable that most of them were scattered over the bed of the North Sea by floating ice, to be afterwards merely ploughed up and carried forward by the ice-sheet.

It might be thought that so recent a period as that of the dying away of the arctic cold would be thoroughly understood; but such is not the case, one of the most difficult problems in Pleistocene geology being to make out the relation of Palæolithic man to the Glacial Epoch. In this respect the County of Suffolk is particularly well situated, for the deposits newer than the Boulder Clay are very peculiar and often highly fossiliferous. At Stutton, on the north side of the River Stour, for instance, is found a brick-earth with elephant

remains and land and freshwater shells, including the southern *Helix fruticum* and *Hydrobia marginata*, both now extinct in Britain. At Hoxne, on the other hand, overlying the Boulder Clay we find an interesting flora, including the dwarf arctic willows, *Salix polaris* and *Salix myrsinites* and the dwarf birch *Betula nana*. Numerous palæolithic implements have been obtained from the same pit, where they were discovered nearly a hundred years since by John Frere. It is to be hoped that the Ipswich meeting will produce some communication on the relations of the various isolated deposits later than the Boulder Clay, for this is a subject that ought more easily to be worked out in Suffolk than in any other county.

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CLEMENT REID.

III.

Some Recent Insect Literature.

IN a former review, contributed to NATURAL SCIENCE (vol. ii., pp. 114–119), I noticed a new description of the ear situated in the tibial joint of the front leg in long-horned grasshoppers. A summary of a recent account of another insect sense-organ with an apparently auditory function may also be of interest. Forty years ago Mr. Johnston was the first to discover that the swollen basal joint of the antenna in certain gnats and midges contained a complicated structure, which he interpreted as an organ of hearing. Subsequent observers have investigated the subject, among the more recent a well-known contributor to the pages of this Review, Dr. C. H. Hurst (1). The latest memoir on the subject (2) is due to the labours of Mr. C. M. Child, whose work seems so exhaustive as to leave but little for future investigators to learn about the structure of the organ, though a considerable field remains for experimental research into its various functions.

In the insects in which this organ is most highly developed, the males of certain gnats (especially *Mochonlyx*) and midges (Chironomidæ), the second joint of the antenna is enormously swollen and cup-shaped, being somewhat concave on its distal aspect. Here, around the insertion of the next succeeding joint, is a plate, called by Dr. Hurst the tympanum, produced into numerous processes, in connection with which are long, rod-like cells, united by means of nerve-threads with large ganglion cells, which are arranged within the outer wall of the swollen antennal joint, and connected with large offshoots of the main nerve of the antenna. In the females of these insects a similar organ is present, but in a far lower stage of development, the antennal joint being not nearly so much swollen as in the males.

The most important point, perhaps, in Mr. Child's work is the discovery of a homologous organ, though in a far more rudimentary condition, in the corresponding antennal joint of insects of several orders. The organ is shown to be present in many other genera of Diptera, in Hymenoptera (*Formica*, *Vespa*, *Bombus*), in Lepidoptera (*Epinephile*), in Coleoptera (*Melolontha*), in Rhynchota (*Aphis*, *Strachia*),

in Neuroptera (*Gibelbula*), in Planipeunia (*Sialis*, *Panorpa*), and in Tricoptera (*Phryganea*). Only in the Orthoptera (*Phasgonura* and *Stenobothrus*) which he examined did Mr. Child fail to find the organ. The presence of the structure in different stages of development in so many different kinds of insects is of considerable interest, as it throws light on the steps by which it has reached the high grade attained in the male gnats and midges. Mr. Child believes, with much reason, that the advance in structure corresponds to an advance in function, from the apprehension of mere touch-sensations to that of definite sound vibrations. There must indeed be a stage at which the former are merged into the latter. In the gnats and midges, where the organ is specially developed in the males, it has doubtless a special sexual function. Dr. Hurst and Mr. Child both point out that experiments have shown the hairs on the shaft of the antennæ of a male gnat to vibrate to the same note which is known to be produced by membranes connected with the thoracic spiracles in the female. The "ear" in the male's antenna, therefore, enables him to ascertain the proximity and direction of a mate, for the hairs vibrate most readily when the path of the sound cuts them at right angles—that is, when the sound comes from the direction towards which the antenna points.

Here, then, we have an instance of the male insect hearing a sound produced by the female. It is well known that in most insects which produce sounds, the musical performance is characteristic of the male; and an old writer has been so ungallant as to congratulate the cicads upon having silent wives. Some observations on shrill, chirping notes produced by small water-bugs of the genus *Corixa* were brought to my own notice last year. Finding that although the sounds had been previously heard by several naturalists, both in Great Britain and on the Continent, there had apparently been no explanation of them offered beyond the fact that the front feet were drawn across the face, I examined those limbs in both sexes of several species. This study (3) showed the presence, in the males only, of a row of extremely fine pegs, or teeth, on the flattened tarsal joint, and it seems evident that these form a musical "comb" which sounds when the foot is rapidly drawn across the sharp edge of the face. Last year a French observer, M. Ch. Bruyant (4) heard similar notes from *Sigara*, a minute relation of the *Corixæ*, and described a similar comb-like instrument as their cause.

While such insects call each other by a "song," others—the humble glow-worm a well-known example—attract by a shining light. An interesting paper by Herr P. Schmidt (5) gives some particulars of luminous midges (Chironomidæ) which have been observed in various parts of Russia, in Pomerania, in Persia and Turkestan, the earliest quoted notice of the phenomenon being a century old. In certain localities the shining midges are said to be so numerous as to make entire shrubs glow with their light. These insects proved,

upon examination, to belong to a form of the common species *Chironomus plumosus*. But Herr Schmidt does not consider that the shining serves any useful purpose, such as that of attracting a mate. It rather appears to be due to the presence of injurious micro-organisms in the body, as all the luminous midges observed were exceedingly sluggish and apparently sickly. The presence of bacteria was, however, not definitely proved by microscopic research. Herr Schmidt compares these insects with a luminous crustacean *(Talitrus)* described a few years ago by M. Giard. This shining individual was evidently sick, being far more sluggish than his companions, and only surviving a few days. Microscopic examination here revealed swarms of *Micrococci* in the foot, while healthy, non-luminous *Talitri* inoculated with these became in their turn shining and sickly.

A lengthy, minute, and laborious memoir on the glands of the Hymenoptera has lately been published by another French naturalist, Mr. L. Bordas (6). He has investigated the salivary glands, the food canal, the renal (Malpighian) tubes, and the poison-glands in several genera of most of the larger groups of the Hymenoptera, comparing the varying developments of corresponding organs in each. Six sets of salivary glands were found in almost all the insects of the order examined, while four other sets were found in some instances. Some of these are grape-like (racemose), consisting of numerous follicles, while others are unilocular; the ducts of the racemose glands are spirally strengthened, like tracheal breathing-tubes. Mr. Bordas correlates each pair of glands with a primitive segment of the head, but careful embryological research will be needed to confirm such a speculation. The food canal is described as it occurs in insects of the various families, and its different regions—fore-gut (comprising pharynx, gullet, crop, and gizzard), mid-gut, and hind-gut, including the rectum—are compared, their elaboration being traced through the pupal stage, from the comparatively simple digestive tract of the larva. The Malpighian tubes in larvæ are only four in number; during the pupal state these disappear, and a much larger number of tubes is developed for the perfect state. These are more numerous in the Hymenoptera than among insects of any other order, more than a hundred being sometimes present; their number is, generally speaking, inversely proportional to their length. Mr. Bordas accepts the view, now generally held, that the function of these tubes is renal; it will be in the remembrance of students of insect anatomy that Mr. Lowne, in his recent work on the blow-fly, maintains the older view that their function is rather hepatic.

The most interesting section of Mr. Bordas' work is, perhaps, his description of the poison-glands in various Hymenoptera. He states that hitherto only those of the hive-bee have been described, and he now figures the organs in many other insects of the order.

There are always two glands present, an acid and an alkaline. The former may consist of a simple tube, of a bifid tube, of paired tubes, or of a bundle of tubes. The epithelial coat of these consists of several layers of cells. They open into a large oval or spherical poison-reservoir, from which proceeds the duct to the sting. The alkaline gland is a somewhat thick, irregular tube, whose epithelial coat consists of but a single layer of cells, thrown into folds; its duct opens alongside that of the acid gland. A third, accessory, gland is present in some cases. A remarkable fact established by Mr. Bordas is that of the presence of these poison-glands (or their homologues), not only in the stinging (aculeate) Hymenoptera —wasps and bees, but also in the boring (terebrant) section of the order—ichneumons, sunflies, etc. The exact function of the glands in these latter insects, which do not sting, would be an interesting subject for research. Mr. Bordas insists that the sting of aculeate and the ovipositor of terebrant Hymenoptera are identical structures. In the concluding part (just issued) of the work referred to above, Mr. Lowne promulgates the same view, and expresses his opinion that the egg is ejected through the basal part, at least, of the sting in bees and wasps.

In a former review (NAT. SCI., vol. iii., p. 446) I noticed Professor Miall's description of a carnivorous crane-fly larva (*Dicranota*). The same naturalist, in conjunction with Mr. N. Walker, has quite recently (7) given descriptions and figures of the larva and pupa of *Pericoma canescens*, another two-winged fly, but belonging to the family Psychodidæ. The very small, hairy flies of this family may often be observed on window-panes, and the larvæ described were found in a paved water-channel and on the banks of muddy ponds. The grub can live either in water or air, and feeds on freshwater algæ. It breathes air by means of two spiracles situated at the end of paired processes, one on either side of the second body-segment (mesothoracic); and two other spiracles at the extreme hinder end of the body. The hindmost segment, on which these latter open, bears four processes, each provided with a number of filaments set with very fine hairs. These feather-like structures act as a cup which encloses air, so that the grub, which "seems most at home in water just deep enough to cover the body," can feed with its mouth at the bottom, while its tail is at the surface. If entirely submerged, as by a sudden flood, the feathery processes enclose a bubble of air, which will serve for respiration for a considerable time, the spiracles being kept dry. When full-grown, the larva leaves the water, and the pupal stage is passed by the insect, buried in the earth or beneath a stone. The pupa breathes by means of a pair of respiratory trumpets on the prothorax. The value of this paper is increased by an appendix, due to Baron Osten Sacken, giving an account of all the literature relating to the development of Psychodidæ. The latest memoir quoted herein is a description, by Dr. F.

Müller, of some Brazilian larvæ of the family, which breathe by spiracles at the hinder end, and also by means of pupillæ in connection with the tracheal tubes. These, protruded in water, function as gills; in air they are retracted.

Dr. H. J. Hansen has lately given us an excellent description with figures (8) of a very interesting and obscure African insect. This is *Hemimerus talpoides*, a small, brown, blind, wingless, cockroach-like creature, described by the late Mr. F. Walker from specimens from Sierra Leone. On account, apparently, of its short, stout legs this naturalist placed it near the Mole-Crickets, a family with which it has no near affinity. Later, Mr. H. de Saumere examined a single dried female, and believed he discovered therein a fourth pair of jaws fused to form a second labium. On the strength of this observation (now shown by Dr. Hansen to have been quite incorrect) *Hemimerus* was afterwards distinguished by being placed in an order all by itself. But though Dr. Hansen has proved the jaws of the insect to comprise the three pairs always characteristic of the class, and satisfactorily settled that it is an undoubted orthopteron, he has been able to note some important facts in its habits and life-history. The specimens which he examined came from the Cameroons, and were found by their captor, in quantity, jumping about on the skin of a rodent (*Cricetomys*) and penetrating between its hairs. Dr. Hansen remarks that the jaws of *Hemimerus* are not adapted for sucking blood, and suggests that it probably does not live parasitically on the rodent itself, but preys upon smaller insects which are truly parasitic. If this be so, the *Cricetomys* has cause for gratitude.

The most remarkable observation made by Dr. Hansen on *Hemimerus* is that the female bears living young in a very advanced stage of development. Several embryos were found in a mother, each less in size than that anterior to it in position. Between the head and the pronotum, in the larger embryos, an unpaired organ was noticed which Dr. Hansen believes to be "in connection with the internal wall of female genital organs, and thus serve the nutrition of the young ones, which are growing to the astonishing size within the mother." That is to say, its function is supposed to be analogous to that of the umbilical cord of a mammal. From the arrangement and comparative development of the embryos, Dr. Hansen concludes that only one is born at a time, an interval of several days elapsing before the next is ready to be brought forth. Such a method of reproduction is unique among insects, though, of course, examples of the birth of many living larvæ at the same time are sufficiently familiar.

Though the general aspect of *Hemimerus* reminds one of a cockroach, Dr. Hansen gives reasons for believing its affinities to be more with the Forficulidæ than with the Blattidæ. He would, therefore, place the insect in a special family not far from that of the Earwigs.

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GEO. H. CARPENTER.

IV.

The Nucleolus.

THE gradual improvement in our optical and chemical means of research has allowed us to peer ever deeper and deeper into that anatomy of plants and animals which lies beyond the reach of our unaided sight. First, it was the cell, consisting primarily of a wall, and, secondarily, of "contents," which was revealed to us. Later, the cell-contents were endowed with importance at the expense of the wall, and were shown to consist essentially of protoplasm and nucleus; at the present day we attempt to push the limits of our knowledge further still, and speak of the finer structure of protoplasm and of the compound nature of the nucleus. We have learnt, thanks to the diligent and patient labours of several observers, that the nucleus consists of many parts. It is bounded on the outside, in some cases at any rate, by a membrane; intertwined throughout its space is a fine threadwork of a substance chemically known as "linin," which is distinguished by the extreme difficulty with which it stains; embedded within the substance of these threads are a greater or less number of deeply staining granules—the chromatin or nuclein-grains; the interstices of this nuclear filament are occupied by a ground-substance of uncertain composition; and, lastly, there occur in most nuclei one or more spherules or variously shaped grains—the nucleoli—with properties peculiar to themselves. It is with these last-named bodies that the present article is concerned.

In the first place, it must be mentioned that the term "nucleolus," like so many other names occurring in the study of the cell, has come to be applied to several things of an entirely dissimilar nature.

Carnoy has classified the nucleoli as they are found in the literature of the cell in the following manner:—

(1) *Nucléoles nucléiniens*, which are merely granules of nuclein, either free or in connection with the nuclear threadwork.

(2) *Nucléoles noyaux*, which form, as it were, a nucleus within the nucleus, being in fact miniature nuclei possessed of all the usual parts, embedded in a substance extremely like, if not identical with, protoplasm, and occupying the rest of the nuclear space. These peculiar structures have been described in Rhizopoda and other animals.

(3) *Nucléoles plasmatiques*, the nucleoli proper. They contain no nuclein, whatever else they may consist of, and they have, according to Carnoy and Zacharias, a definite structure.

A peculiarly interesting case is to be found in the nucleus of *Spirogyra*. Here is a network winding through the nuclear space which, from the small effect of the ordinary stains upon it, we can conclude consists of linin with but few granules of nuclein embedded in it. This latter substance appears to be aggregated into one or two comparatively large spherules, which are usually spoken of as "nucleoli." But since by the unqualified term we mean only the nucleoli proper, the *Nucléoles plasmatiques* of Carnoy, the name is evidently misapplied in the case of *Spirogyra*. The spherules are to be spoken of according to Meunier (16) as *Nucléoles noyaux*, or, to follow Moll and others (17 and 10), as *Nucléoles nucléiniens*, but not as nucleoli simply.

Such determinations as the above, in which we are guided by morphological features and micro-chemical reactions, would be greatly facilitated if we knew more of the part played by the true nucleolus in the general physiology of the cell. As the case stands, we know but little of the functions of the nucleus as a whole, and still less of the duties of its component parts. With regard to the nucleolus, opinions are most divergent. One body of observers maintains that it is merely a reservoir of food-material for the more vitally active portions of the nucleus, whilst another group holds that it itself takes a prominent part in the performance of the life-activities of the cell. Strasburger, Carnoy, Pfitzner, and others, have all spoken for the former view, while the names of Flemming, Zacharias, and Oscar Hertwig may be mentioned among those who support the second theory.

The observations by Flemming (7), Bütschli (4), and Rosen (19) of the frequent occurrence of vacuoles in the nucleolus may have some bearing upon this point. Rosen, moreover, affirms that these vacuoles are particularly abundant in plants, and that they are filled with tannin. This, however, seems to be extremely doubtful. Many careful examinations, notably those of Büttner (3), point to the entire absence of tannins from the nucleus.

In forming a distinction between nuclein-grains and nucleoli, which are the two things most often confused, the safest guide we can follow is the dissimilarity in their behaviour during cell-division; the nuclein bodies will be seen, upon the entrance into activity, to break up into the chromosomes or nuclear-segments, while the nucleolus will to all appearances vanish altogether, probably becoming dissolved in the nuclear sap. A second datum of almost equal importance, which must be taken into account in forming all conclusions as to the nature of the nuclear structure observed, is its behaviour with micro-chemical reagents. So difficult, however, is the investigation of these minute parts of the nucleus that we cannot

wonder at the great divergence of opinion upon their nature, both structural and chemical.

Many great masters in the study of the cell grant a distinction between nuclein-bodies and nucleoli only with the greatest hesitation. Strasburger (1882) in his work, "Ueber die Theilungsvorgänge der Zellkerne, etc.," believes that the two bodies are but different stages of development of the same thing. He thinks that as the nuclein-bodies increase in age, they grow, and that with their growth a change in their power of staining takes place, so that they ultimately reach the size and have the properties characteristic of a nucleolus. In a later work (24) Strasburger fully grants a dissimilarity in the substance of nuclein-grains and nucleoli, basing his opinion partly on their relative solubilities in various solvents, and partly on their different behaviour during cell-division. In a yet more recent writing (25) we find Strasburger mentioning the similarity of reaction of nuclein and nucleolus. The same hesitation in the expression of a definite opinion is to be found in Guignard (8); he, like Strasburger, believes in the passage of the nuclein-grain into a nucleolus. As the former body increases in size it undergoes a chemical change, so that it reacts differently towards colouring fluids at different periods of its existence. According to this theory, therefore, we may meet in the nucleus with nuclein-grains possessed of their distinguishing reactions; we may meet also, side by side with these, with other grains, the chemical behaviour of which is dissimilar from that presented by nuclein, and yet different from that of the nucleolus; and we may meet besides with yet other grains, larger in size, and different in chemical properties from either of the two former ones, which are stamped by their peculiarities as veritable nucleoli; and all these three things (and under the second heading may be included many varieties) are but phases of one and the same body.

Flemming (7) sees a radical difference between nucleoli and nuclein-bodies; so also Pfitzner (18), who studied the nuclei of *Hydra*. Jurányi (14), on the other hand, regards the nucleoli as thickened parts of the nuclear threadwork, and hence as consisting of nuclein.

Schmitz (20) not only classes nucleoli and chromatin-grains together, but includes in the same category the pyrenoids, those curious bodies with a still obscure function which are met with in the chromatophores of many Algæ. The grounds for this belief seem, however, to be insufficient to bear it out. Zacharias has shown that there is a certain similarity between nucleoli and pyrenoids, but that it is not a close one, and that, moreover, both these bodies are sharply distinguished from nuclein.

In 1881 Zacharias published the first of his series of articles on the micro-chemistry of the cell; they have appeared in the *Botanische Zeitung*, and their value can be best expressed by saying that they are among the most important contents of a periodical in the pages of

which lie the very foundations of botanical science. In his earliest contributions (29) he ascribes to the nucleolus a two-fold structure; it consists, he says, of comparatively dense and resistant plastin, and of more easily soluble proteids. Plastin, it may be remarked here, is the characteristic proteid of the protoplasm, of which it forms the framework, and Zacharias has been led by his observations to conclude that it is likewise the framework of the nucleus and its parts; hence, instead of employing the special term "linin" for the nuclear threadwork, as is done by many other authors, he uses "plastin" to denote the formed constituent both of the protoplasm and of the nucleus.

Carnoy has also come to the conclusion that the nucleolus consists of dense plastin and of less dense proteid substances, but of no nuclein. In 1885 Zacharias issued his article on the "Nucleolus" (30). He examined particularly the case of *Galanthus nivalis* (Snowdrop), because here he was able to obtain large and favourable examples. These observations fully bore out his former views, and he further was brought to the belief that the plastin may be considered as arranged in a network, with the other proteids occupying its meshes. But of this he makes no positive statement, waiting for others to confirm these points.

In the last-mentioned article we find the behaviour of the nucleolus towards various solvents and staining reagents very fully discussed. With pure water, it seems, the nucleolus is unchanged, while the other nuclear parts, including the chromatic portions, swell up and become transparent, thus rendering the nucleolus particularly evident. As the water is further imbibed into the nucleus, this increases in size, and finally bursts, liberating the nucleolus as a shining, sharply defined body. Alcohol also brings out the nucleolus clearly. Prolonged action of 10 per cent. sodium chloride solution extracts from the nucleolus a portion of its substance, and leaves behind a part which has a loose constitution and slight power of staining. A somewhat similar removal of a portion of the nucleolar substance is brought about by the penetration of artificial digestive fluids. These render the nucleolus indistinct, and cause a diminution in its size; the remnant which is left behind no longer stains with neutral carmine solution, and a 10 per cent. common salt solution has no action upon it. The digestive fluid leaves the nuclein-grains unaffected, and it can be seen that, abundant as these may be in and around the nuclear threadwork, they are entirely absent both from the nucleolus and the protoplasm. The action of common salt and of digestive fluids upon the nucleolus gives great probability to the view that this structure consists, as Zacharias and Carnoy affirm, of two separate materials, and is not built of a single substance (pyrenin) as Schwartz and others maintain.

The action of carmine stains also sheds considerable light upon the constitution of the nucleolus. Neutral carmine colours that part

of the nucleolus which digestive fluids abstract; the digestive-remnant and the nuclein-grains of the nucleus are left unstained. Alkaline solutions of carmine colour the nucleoli rapidly and deeply, but act on nuclein only slowly and never very intensely. Acid carmine solutions have precisely the opposite effects, being especially nuclein stains with little action on nucleoli. This behaviour with different carmine solutions again points to the two-fold structure of the body in question, and to the entire absence of nuclein from it.

In direct contradiction to these views Schwartz (22) asserts that the nucleolus consists of a single substance—pyrenin, which has a close chemical resemblance to the material composing the wall of the nucleus, and which he accordingly names "amphipyrenin." This pyrenin exists, he says, in two modifications, the soluble and the insoluble forms, the former being found in young nucleoli, the latter in those which are older; but what is to be clearly borne in mind is that both forms are chemically similar, and hence to be included under the single name of pyrenin. He has studied the action of different reagents upon the nucleolus most carefully and patiently; but invaluable as his results are, it would be out of the question to enter into their details here. It may be mentioned, however, that they frequently are at variance with those of Zacharias; for instance, Schwartz believes it to be extremely probable that the substance of the nucleolus is in itself soluble in water (in contradiction to Zacharias), but that upon the injury of the cell in examination, the penetration of acid substances or tannins contained in the cell-sap of the protoplasm fixes and renders the nucleolar substances insoluble. He fully bears out Zacharias in the opinion that nucleoli are entirely dissimilar from chromatin-grains.

Another interesting point connected with the nucleolus is the change which this undergoes with increasing age. We are very largely indebted to Johow (13) for information in this respect. There seems to be a decrease in size, and often an entire disappearance of the nucleolus in older cells; moreover, in cells which no longer undergo division, the nucleolus exhibits slow changes of form, more or less amœboid in nature (*e.g.*, cells of *Chara*), the pseudopodial processes becoming separated from the main body of the nucleolus, and drawing themselves together as a number of disconnected granules, still giving the ordinary nucleolar reactions.

In what has already been said it will be seen that there is much which is uncertain and undetermined; but there yet remains a question to be dealt with which surpasses all else in point of indecision and variety of opinion. This is the inquiry into the fate of the nucleolus during cell-division.

The only point as to which there is a consensus of opinion is that the nucleolus, at the time of activity, disappears. What becomes of it? Which, if any, of the new structures appearing in the nucleus

(or in the protoplasm), may be derived from the nucleolus? These are at present open, although much-discussed questions.

Some have thought that the nuclear-spindle owes its origin to this vanished structure, others, and perhaps the majority, including Flemming (7), Jurányi (14), and Went (27), are of opinion that there exists a direct connection between the nucleolus and the chromosomes. Strasburger (24) also sees a connection between these two things, but not a direct one. The nucleolus, in his belief, is dissolved in the liquid portions of the nucleus (nuclear-sap), and part of it may then serve as a food-stuff to the chromosomes, and be absorbed by them whilst the rest remains behind in solution. When the daughter-nuclei are formed, the nucleolar substance collects together from the threadwork and from the nuclear-sap to form fresh nucleoli. Since, as has been pointed out above, we have very good reason to believe in the dissimilarity between the materials of the chromosomes (nuclein) and the materials of the nucleolus, it is not easy to see how any such relations can exist between the two.

Zacharias (30) has watched the disappearance of the nucleolus from the cells of *Chara*, in which he noticed that it loses its definite outline and changes its shape in slow amœboid movements, becoming at the same time diminished in size, finally to vanish altogether. He thinks that it is probable that the more easily soluble proteid constituents of the structure are dissolved, whilst the plastin framework remains intact, but hidden by other plastin elements in the dividing nucleus.

Of late days, much attention has been given to those structures of the cell spoken of as attraction-spheres and their central-particles or centrosomes.

The exact life-history of these organs of the cell, for so we may term them, is not yet ascertained, but much speculation has been rife in connection with it. Only one of these hypotheses will interest us in the present article, it is the one recently propounded by Karsten (15). In studying certain cells of *Psilotum* he found, at the time of division, the nucleoli, of which there may be several, lying close to the periphery of the nucleus and, on the absorption of the nuclear-membrane, two nucleoli passing out into the protoplasm and taking up their positions at the poles of the nucleus. He further asserts that in some cases he was able to detect a distinct radiation around each nucleolus, and from these observations he concludes that the nucleoli give rise to the centrosomes of the attraction-spheres, and are subsequently re-formed into the nucleoli of the daughter-nuclei.

Another theory of considerable interest, and of recent date, is that of A. Zimmermann (32). In the opinion of this observer, the nucleoli wander out of the nucleus at the time of division and find their way into the protoplasm as bodies of varying size; when nuclear division has taken place, it is probable that the nucleoli travel back to the daughter-nuclei and once more fuse together into the

ordinary nucleolus. The grounds for this belief are certain observations on the micro-chemical behaviour of cells of *Equisetum*, *Psilotum*, *Vicia faba*, Liliaceæ, etc., in which it was noticed that, at the time of nuclear activity, particles, some large, some small, appeared in the protoplasm, and that these gave all the characteristic reactions of the nucleolus. With regard to these theories of Karsten and Zimmermann, the observations of Guignard, lately recorded in an article on the origin of the attraction-spheres (9), have no small significance. The centrosomes, he says, are always and invariably (in the plants examined) to be found outside the nucleus, and, although at certain periods of nuclear division the nucleoli may be seen lying in the protoplasm in the neighbourhood of the spheres, yet nucleoli and centrosomes are always distinct from one another. In the formation of the spore-mother cells of *Psilotum* the nucleoli, which are present in numbers, were seen to find their way into the protoplasm, and then to diminish in bulk, although their ultimate fate could not be made out. Thus the researches of Guignard support the views expressed by Zimmermann, but stand at variance with those of Karsten.

From the foregoing it will be perceived that our knowledge of the chemical, structural, and physiological relations of the nucleolus is still very imperfect ; but when we recollect how extremely minute this structure is, we must feel that we should not reproach ourselves with this uncertainty, but rather marvel at the skill and patience of those who, after all, have told us much already. Their chief praise, however, is that they have started us upon a new line of research which promises to bring us nearer than any previous one to the highest problem of biological science; for it is indisputable that within the cell lies hidden the riddle of Life, which has been a puzzle to mankind through all time.

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RUDOLF BEER.

V.

The Rôle of Sex.

Part I.

The Use of the Term Sex.

ACCORDING to Skeat the word sex—*sexus*—is derived from *secare*, to divide. If this is true, the word "to divide" was modified to express that which is divided or distinguished from something else; thus, we have the male sex or division, and the female sex or division. By a further extension of the use of the word we have the sexual organs, or sexual instincts, meaning those parts or qualities on whose difference the division or distinction depends. Both in the early use of the term and in its modern every-day application, it is the difference between the sexes which is felt to be the outstanding character which merits notice, and requires indication in the name given.

But biologists who have studied the lower forms, both of animal and of plant life, have discovered that the simpler the organism, the fewer are the characters which distinguish the sexes from each other; until forms are finally reached all the members of which are precisely similar to each other and show no indication of sex—maleness or femaleness. Nevertheless, these little organisms sometimes conjugate with each other as a preliminary step to reproduction, and in this respect resemble higher organisms where the conjugating individuals are different. Thus *Ulothrix* produces microspores which coalesce with precisely similar microspores from other individuals, and these subsequently develop to adult size and character. Biologists recognise that reproduction with conjugation is a character which *Ulothrix* shares with higher animals, and they have so extended the use of the term sex as to include as examples of sexual reproduction the conjugation of types precisely similar to each other; types which, like *Ulothrix*, show no indication at all of maleness or femaleness. Thus it has come about that a word, originally meaning "to divide," is now, in a strictly technical sense, used to indicate "that which joins," and this is one of the many instances which exist of words which completely change their meaning during the gradual growth and development of language.

By this useful and perfectly justifiable extension of the term sex,

we can distinguish sexual reproduction—that is, reproduction after conjugation—from reproduction in which no conjugation takes place, or asexual reproduction.

For an example of the latter we have not to go far, for the microspores of *Ulothrix*, if they fail to meet and coalesce with other microspores, may develop by themselves, gradually growing into adult specimens.

It will be observed from the foregoing that in a study of sexual reproduction we have two important and quite distinct problems to discuss, problems which have unfortunately too often been treated as if they were one. In the first place, we may concentrate the attention upon the act of conjugation, and enquire as to its utility; and in the second place, we may seek for an explanation of how it is that in the vast majority of cases the conjugating forms are dissimilar to each other, and may therefore be termed male and female. It will be convenient to study the second problem—that of sexual dimorphism—first, chiefly because its solution may clear the way for the first and by far the most obscure question, "why should organisms conjugate at all?"

Sexual Dimorphism.

There can be little doubt that the earliest form of conjugation was between forms similar to each other and exhibiting no sexual difference, and that sexual dimorphism arose subsequently. This is believed because in existing organisms it is only in very simple and primitive types that we find the absence of sexual differences, and these differences become most pronounced in more highly organised and later types.

If we enquire why dimorphism arose, we naturally ask ourselves the question, what can have been and what are its special advantages? To show the existence of an advantage, will, by the light of Darwin's work, give at any rate a complete and reasonable hypothesis for the development of dimorphism. Accepting the fact that living organisms constantly tend to vary in an almost infinite number of ways, we can readily understand how, at one time or another in the history of a species, individuals might be met with whose reproductive cells differed considerably from each other, say in size. If now it can be shown that, for purposes of conjugation, or for anything else, this variation had a distinct advantage over ordinary members of the species whose reproductive cells were all of the same size, then we may rely on natural selection for the perpetuation of this fortunate variety. While the gift of a purse might be of advantage to a beggar in our streets, it would little avail the traveller dying of thirst in the Sahara: a possession, a power, a property may be of advantage to one and not to another; for this point will be determined by their conditions of life. Probably sexual dimorphism would not be of advantage to those lower forms which do not possess it; otherwise it is difficult to imagine its non-occurrence and non-preservation through

variation and natural selection. Equally probable is it that sexual dimorphism is or was of advantage to those forms which now possess it.

If now we study the conditions of life, both of those which are not, and those which are, sexually dimorphic, and if we find certain conditions absent in one case and present in the other, we may assume, at any rate provisionally, that these latter conditions determined sexual dimorphism by making it advantageous wherever it should appear as a variety.

If we study in detail some of the life-histories of the lower forms, both those which are dimorphic and those which are not, we shall find that wherever certain difficulties in the way of conjugation appear, there dimorphism is also present.

Those forms which, though conjugating, are not dimorphic, are of the most simple structure, consisting of single cells, or small colonies of these. In all cases, so far as I can determine, conjugation is most easy and effectual, for they are either (1) free swimming, (2) free crawling, or (3) they are nearly opposed to each other. As an example of a free swimming form we may take the *Paramœcia*, which are free swimming and active infusoria. When conjugating, two individuals come in contact by their ventral surfaces, exchange nuclear matter, separate, and then divide. Of three *Paramœcia*—A, B, and C—A may conjugate with B or with C, or B may conjugate with C; three possibilities, two only of which could, of course, take place were a sexual difference present. As another example of a free swimming form, *Heteromita* may be instanced.

As an example of a freely crawling form, we may take *Amœba*, which crawls along by the aid of its pseudopodia. Conjugation has recently been described in this form—two individuals meeting and completely fusing as a preliminary to subsequent division.

As an example of individuals which are from their position in easy reach of each other, we may instance *Spirogyra*, whose long filaments lie side by side in the water. From these, short processes arise, springing from the contiguous borders of neighbouring filaments; they pass towards each other, join, and their contents become united. In some forms of *Spirogyra* the processes differ from each other in activity, the only indication of dimorphism present.

Other examples of plants living in close contiguity and where conjugation is remarkably easy, may be taken from the *Confervoideæ isogamæ*.

When we pass to the examination of the conditions under which dimorphism exists, we find that dimorphic forms are either (1) simple cells, which are fixed and far apart from each other, or (2) individuals that have undergone cell-differentiation, with the result that the reproductive matter is contained within special reproductive cells. In both cases, as we shall see very soon, there are certain difficulties in the way of easy conjugation.

As an example of simple fixed cells we may take the case of

Vorticella. These are fixed by a stalk to weeds or stones, and of course they are unable to cluster close to each other for lack of food. In order that conjugation may occur, the *Vorticella* generally divides into two halves, one of which re-divides into from two to eight parts. These become ciliated and free swimming; they swim to and conjugate with an ordinary stalked *Vorticella*.

By far the larger number of instances of dimorphism are to be found in higher and more complex animal and vegetable forms. Here, the individual consists of cells, some of which exist for protection, others for movement, others for purposes of nutrition, and others, again, are the reproductive cells. Here, we meet with two distinct kinds of dimorphism, both of which may be termed sexual. In the first place, the special reproductive cells, or gametes, are different from each other, and this we may term *dimorphism of the gametes;* and in the second place, the whole individual may be dimorphic, *dimorphism of the individual.*

Thus, in *Hydra*, one individual specimen produces two kinds of reproductive cells or gametes, and these may be termed male and female gametes. One individual hydra does not, however, differ from another individual hydra—there are no male and no female hydras: the individual may be termed hermaphrodite, from its producing both male and female gametes. In by far the larger number of plants and animals a division of labour occurs, and the male gametes are produced by one individual, the females by another, so that in this case we may speak of a male and female *individual*, more especially as these individuals generally come to differ from each other in qualities other than that of merely producing different reproductive cells.

Dimorphism of the Gametes.—Now it is very probable that the first indication of dimorphism was the production by individuals not dimorphic themselves of gametes which were dimorphic, and that dimorphism of the individual was a subsequent product. The reason for this belief is the fact that the more complex double dimorphism prevails to a greater extent in higher than in lower forms of life. Concentrating our attention upon the dimorphism of the gametes, we find that, as already indicated, it is associated with certain difficulties in the way of conjugation. In *Vorticella* these are obvious, and hardly less so among animals which have undergone cell-differentiation. Even where individual dimorphism has furnished special ducts and organs for bringing the gametes together, these, on account of their small size (they are generally microscopic) have got to travel what is for them a considerable distance before conjugation can occur. While we may allow that dimorphism is present in association with difficulties in the way of conjugation, we have only taken the first step in our investigation; we have yet to understand how dimorphism can overcome these difficulties.

We might suppose that the production of moving gametes would

be sufficient to bring conjugation about, and we have still to explain why the gametes are of two kinds, female and male; we have, in fact, to explain why of the two kinds of reproductive gametes the first are large, and are approached by rather than approach the other kind (these we term the female gametes, ova, etc.), while the second are small, actively approach, or are carried by outside agencies to the female gametes (these we term male gametes, sperms, etc.). Now, the utility of this dimorphism will be apparent when we call to mind certain facts in the physiology of the early stages of reproduction. A reproductive cell is a highly differentiated cell; it contains matter capable of reproducing a new individual, but is devoid of the power of assimilation and nutrition. It has no organs for feeding or digesting food, for then, indeed, it would be fully equipped for all the main purposes of life; it would be a person or an individual. After it has started away from the parent organism, its life as a gamete must necessarily be short, and every movement it makes, every hour it lives, expends some of its limited potential. When the gametes conjugate, and active development occurs, some time must elapse before organs of nutrition are formed, and all this time capital must be used up, and they must have, one or both of them, a supply of capital at hand. In the case of many animals—the fowl, for instance—the store of capital is very great, and weighs hundreds of times more than that part which directly develops into the chick. The gametes, therefore, not only require to be brought together, but after conjugating, they must start life with sufficient capital.

If both gametes were motile, and carried each of them a portion of this capital—frequently very abundant—it is evident that a great expenditure of energy would be required. The conditions, actually in existence, where the capital is a part of the quiescent cell and the moving cell only carries its hereditary material, conduce to the saving of energy, and are, therefore, advantageous. In the case of the fowl's egg, no existing cell could propel even a small fraction of its substance; but leaving such an extreme case, we find that the female gamete, with its store of capital in almost every species that can be named, is many times greater than the male gamete. The advantage of having this store of capital lodged with the quiescent gamete is obvious; but the dimorphism which we find in nature has other advantages in addition to those just mentioned, and one of the most important appears to me to be the following:—If both sexual cells were similar and motile, conjugation would rarely occur, because it would be impossible to "time" them in their chase for each other. Suppose that a hypothetical individual (A) gives off moving gametes, and that another individual (B) gives off similar gametes, and that new individuals are produced by the conjugation of the gametes of A and B; unless A and B had some method of timing the formation of these gametes, A might, and probably would, form its gametes at a time when B had none at all. The arrangement that actually obtains

has a very obvious advantage over this conceived condition, for the gametes swim about until they find a large and quiescent form, which is waiting, and can wait an indefinite time for their appearance. In the case of the fish and frog the motile cells are discharged over the quiescent ones, and in the case of the mammal the motile cells are discharged into a duct containing the ova. Here, were the ova motile, there would be less likelihood of their meeting, for they would probably move away from the spot ultimately reached by the motile cells.

We can see that dimorphism is a necessary corollary of the existence of certain conditions, and we see how, supposing that *Volvox*, for instance, at one time or another produced several cells all of one kind, any variety of *Volvox* which developed some of the cells large and quiescent, and others small and motile, would have a distinct advantage, which might lead to the perpetuation of the variety.

Dimorphism of the gametes permits, we have seen, the act of gametic conjugation to take place in a very economical way, and more economical than if the gametes were similar. We may now very naturally ask whether or not dimorphism plays any other rôle than that we have assigned to it. This may very likely be the case, but at present it is difficult to find any characters which distinguish all male from all female gametes, other than those already described; their dimorphism seems to be adapted to economising of energy and nothing more. Of course it is not intended to discuss peculiarities of the gametes special to a species, arising to suit special conditions, but reference is made solely to those points which are of general application.

In their erudite work on "The Evolution of Sex," Geddes and Thompson, struck with the size and quiescence of the female gamete, and with the small size and frequent activity of the male gamete, view the female as preponderatingly assimilative or anabolic, and the male as preponderatingly katabolic. The female gamete builds up her bigger self; the male gamete uses up the trace of capital he possesses in active mechanical movements. This, of course, implies a constitutional difference between the two gametes—a building up and a breaking down constitution. It appears to me very doubtful whether the evidence, taken as a whole, points in this direction, and for the following reasons. Many gametes—pollen-grains, for instance —do not possess the power of movement. They are inert masses, small in size, and carried by the wind or by the aid of insects. We have no reason to suppose them more katabolic than the ovules, unless we have indication of this in the presence of tissue metabolites, or unless we have evidence of active protoplasmic movement which we know must result in metabolites. This evidence is wanting, or, at any rate, very incomplete, and we cannot fall back upon their smaller size; for though smaller, it by no means follows that they are more katabolic. The most katabolic cells in the body are, perhaps,

the muscle cells, and yet they are the largest. We are driven back, therefore, to our first statement, which appears to contain all the facts of universal application at present known, namely, that there are gametes which are larger, contain capital, and are approached by the others—these are termed female; and there are those which are smaller, which actively approach, or are passively carried to, the ova—these we term male.

Dimorphism of the Individual.—Having indicated the obvious advantages which result from dimorphism of the reproductive cells, let us now turn to a consideration of the individual as a whole.

Volvox produces both motile—male—and large quiescent—female—sexual cells. But *Volvox* A is like *Volvox* B, every specimen producing both male and female cells. *Volvox* as an individual has no sex, strictly speaking. *Qua* reproductive cell there is sex difference—dimorphism; *qua* individual *Volvox* there is no such difference.

In by far the greater number of higher forms the male cells are carried by some, the female cells by other, individuals; there is a division of labour, and here *qua* individual we may introduce the terms male and female: there is individual dimorphism. In most cases the two individuals are modified on different lines, and this modification is, we find, always associated with some useful purpose. Organs are specially developed to bring about the more complete mixing of the reproductive elements, other organs to aid the nutrition and development of the young, other organs for protection or active aggression. Division of labour, an obvious economy, necessitates the possession of the organs of nutrition by one individual—the female—and of organs of defence by the other—the male.

These sexual differences, as we term them, vary both in kind and degree. Except by dissection, we cannot distinguish those fish whose sole functional difference is, in one case, to produce ova and discharge them in the sea or on the river bottom, in the other, to produce sperms and discharge these over the ova. The male stickleback, on the other hand, with his multifarious duties of builder and guardian, is distinguishable at once from his mate; and the sexes in the rays and dogfish are very distinct, for here, again, important and different duties are undertaken by each of their sexes. The starfish, which produces sperms, is, both in external and internal structure, similar to the starfish which produces eggs, for in this class the duties of maternity and paternity are usually no more than to grow their reproductive cells and simply discharge them into the sea where they conjugate and develop. In the mammal, where the ova develop within the mother, important structural differences exist between the sexes; the mother becomes a nurturing individual, and the father a protecting one.

If we now turn to a study of dimorphism of the individual, with a view of determining whether or not there are any characters common to all males, or whether there are any characters common to

all females, we shall, I think, encounter difficulties similar to, and as great as, those which beset the question, "Are there any characters common to all animals which separate them from all plants?" Every species has its peculiar dimorphism, and only in nearly allied species are these dimorphisms similar. The organs of copulation present in the mammal are absent in a large number of non-mammalian types; in one form the hair, in another form the horns, in another form the wattles, in another form a different pigment of the skin or plumage, serves some useful purpose and distinguishes the sexes. The attempt to establish the male sex as preponderatingly katabolic, and the female as preponderatingly anabolic, falls to the ground as soon as we carefully examine the case. If we take size—an unsatisfactory test at most—as an indication of a preponderance of anabolism, we find examples of both females and males who are larger than their partners in life. The female dipteron, ant, spider, or frog may be larger than the male, but the male bird generally, and the male mammal invariably, is bigger than the female. As to an active katabolic constitution, it is true that some males are more active than their partners, but it is doubtful whether this is the case, say, with the carnivora and with most birds; there is no difference in the starfish, and the advantage is with the female in those cases where the male is parasitic.

It is highly probable that plants and animals developed out of very primitive forms, adapting themselves in a thousand ways to their surrounding conditions, so that we can find among some plants and some animals almost every quality possessed by living beings. It is impossible to say that a certain quality A is present in all plants and distinguishes them from all animals, and the attempt to find such qualities, at one time considered so important a matter by biologists, is being given up. Now, in just the same manner, we are bound to believe that the individuals carrying the male and female cells became modified in a thousand ways; so much so that there is no quality which serves to distinguish all male from all female individuals, except, indeed, that they carry respectively male and female reproductive cells.

J. B. HAYCRAFT.

VI.

The Alleged Miocene Man in Burma.

THE November number of NATURAL SCIENCE and of the *Geological Magazine* contained notices of Dr. Noetling's paper "On the Occurrence of Chipped (?) Flints in the Upper Miocene of Burma," in the course of which the reviewer accepts as an established fact that worked flints have been found by an experienced geological surveyor in a stratum of either Upper Miocene or Lower Pliocene age—a statement which appears to have found its way without qualification into other periodicals, and even text-books. Dr. Noetling was obliging enough to show me over the locality where these flint fragments were found, and as the question of the existence of man in these Miocene beds is too important to be settled by the *ex cathedrâ* statement of even so eminent an authority as Professor Rupert Jones, I would offer the following remarks, in the hope that they may inspire that due amount of scientific caution which is desirable where a conclusion so revolutionary is still incompletely established.

There are two distinct issues which must both be decided affirmatively before we can say that the existence of man in Miocene times in the Irawadi valley has been proved. First, are the flakes of Miocene age? secondly, are they of human origin? The second I do not propose to discuss; but with regard to the first, the statement that a flake was found partially embedded in the rock requires, in the circumstances of the present case, an explanation. The site is on a spur running out into one of the valleys which have been cut back into the plateau; the crest of this spur falls somewhat rapidly and then rises slightly to the outcrop of the ferruginous conglomerate, whose exposure on the crest of the spur is, to the best of my recollection, about 50 ft. long by 8 to 10 wide. No vestige of soil or sand is here, all having been removed by rain and wind, but there is a thin coating of ferruginous gravel overlaying the solid rock, and it was on this surface, as pointed out to me by Dr. Noetling, that the flakes were found. Ordinarily, there would be no hesitation in ascribing anything found in this layer of loose material to the underlying rock; but it is not the same as finding a flake, or fossil, embedded in a bare vertical exposure below the level to which the rock had been loosened by weathering. It must be remembered that the degree of proof

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required varies inversely with the inherent probability of the proposition to be proved, and when we are dealing with the evidence for the existence of Tertiary man, we must demand most irrefragable evidence both of the derivation of the remains and of the age of the stratum they are supposed to be derived from. In the present case the latter is clear enough, but as regards the former there is a possibility of the flakes, if products of human handicraft, having been dropped on the spur, or washed down from the plateau above, and subsequently become partially embedded in the weathered surface; the possibility being rendered more probable by the fact that the implements are not confined to the outcrop of the fossiliferous ferruginous bed, but are scattered over the surface of the plateau above.

Under these circumstances, it cannot be said that the Tertiary age of the flakes has been proved, and till more complete evidence has been produced it is impossible to accept the existence of man in either Miocene or Pliocene times as one of the established facts of geology.

R. D. OLDHAM.

SOME NEW BOOKS.

The Tradition of the Flood.

On certain Phenomena belonging to the close of the last Geological Period, and their bearing upon the Tradition of the Flood. By Joseph Prestwich, D.C.L., F.R.S., F.G.S., etc. 8vo. Pp. xii., 87. Macmillan and Co., 1895. Price 2s. 6d. net.

The author's life-long researches into the evidence of repeated changes in the level of land and sea, their causes, results, and relative order in succession, more particularly in the British Islands and Western Europe, have proved to be of great value to his fellow-geologists in elucidating the geological structure and history of the regions concerned. They have also enlightened many amateurs and other inquirers on collateral subjects, such as the local and general supply of coal and water, the distribution of particular soils, and as to special topographical features—for instance, gravel-terraces at different levels.

One geological feature among others has especially attracted his attention and had his careful consideration to a great extent, namely, a widespread superficial coating of loose material, consisting of broken rock-matter, but forming neither common gravel and loam, nor soil and humus. This was recognised, to some extent, and called "head" by De la Beche and Godwin-Austen. Prestwich defines it as a special class of "drift," which he calls "rubble-drift." It occurs on hillsides as fragmentary stones mixed with broken bones; also in some clefts and hollows; on coasts it covers old ("raised") beaches, and on some plains and plateaux it forms part of the widespread loamy beds known abroad as the "Lehm," or "Loess," but, like the foregoing, commingled with land-shells and the bones of land animals. These bones may be broken, but have not been worn by transport in rivers, or by glaciers or coast ice, nor have they been gnawed by beasts of prey. Hence the author long ago deduced the conclusion that they must have been dispersed from local centres by water pouring off rising areas of ground after having been submerged by the subsidence of land under water. During this earlier change of level the creatures sought higher and higher levels for safety, and, dying there, their remains were brought down by the retreating waters during the emergence of the land, whether by slow, sudden, or intermittent elevations. The loose ruins of the rocky structure of the tops and slopes of the high places, whether frittered away by frost or by alternate heat and cold, and left, perhaps, for ages before the submergence, came down at the same time, often breaking and crushing the larger bones where the diluvial rush or local precipitation into fissures was greatest. Large areas have been swept bare, slopes, hollows, and clefts retaining some of the *débris* or detritus.

This hypothesis of a widespread and relatively short submergence, followed by early re-elevation, seems to the author to satisfy all

the important conditions both of the problem of an extensive deluge, and of the nature and disposition of the "rubble-drift" or "head."

In this exposition of his views on the subject, Dr. Prestwich treats briefly of the Mosaic and Chaldean accounts of the traditional deluge; and gives his reasons for not accepting as satisfactory the supposition of its having been a valley flood in the Babylonian region.

He also premises that extreme Uniformitarianism cannot be allowed to have any force against his explanation; for "uniformity in degree in all time" is not allowable, though the law of "uniformity in kind" cannot be questioned. It is evident that upheavals and down-sinkings have taken place in many periods of the Earth's history; but their relative intensities may and must have greatly varied.

The geographical distribution of the rubble-drift in England, the Channel Islands, France, Spain and Portugal, Italy, Sicily, Malta, and other Mediterranean Islands, Greece, and the coasts of North Africa and of Asia Minor, is broadly sketched, and careful descriptions of special examples are given in detail, with some illustrative sections.

The author remarks that the absence of marine remains in the rubble-drift might be thought to be inimical to the idea of its having been formed by sea-water retreating from the land after having submerged it for some time; but he thinks that the time was too short, and the water too much muddied with the recent wear and tear of surface-soils, for sea animals to have thrived there. The absence of water-channels and of water-worn material shows that the rubble-drift was not due to exclusive rainfall and river-action. Nor could the conditions of the Glacial Period have coincided with this drift-formation, for ice-sheets would not have allowed of the existence of the creatures whose remains are met with in the rubble; moreover, the land-shells would have been broken, if present, and the bones of animals would have been rubbed and worn. Nor does a "wave of translation" embrace sufficient probable results to account for many of the observed facts.

When these changes of level took place, Man must have existed, for his implements, chipped out of flints, are present at many places in the rubble-drift, having been swept off the surface all over the area treated of by the author, as well as in such cave-earths and loess (sometimes with human bones) as were contemporary with it. The relative date of the rubble-drift can be calculated, though not clearly, from the extent to which it has been worn away on cliffs; and (coincidently) from the probability that Palæolithic Man existed at the close of the Glacial Period, within a period of from 10,000 to 12,000 years of our own time.

With these observations on facts and theoretical deductions, Dr. Prestwich seems to have found good cause to express his opinion that natural results from changes of tension in the mobile earth-crust would bring about oscillations of land and sea, such as have often happened; and that such a change gave rise to a submergence, and subsequent emergence, seriously affecting certain regions, their surface and their inhabitants, within the history of the human race.

He recognises the absence of direct evidence as to similar diluvial materials existing far eastward of Europe, in that region where the "Mosaic Deluge" has always been supposed to have occurred. The extensive European area, however, where the move-

ments of land necessary for the incursion and retrogression of sea-water must have taken place, is quite sufficient, he thinks, to have driven a large proportion of the then existing populations to hills and mountains as places of refuge; from which centres those that survived proceeded in time to re-people the low-lands, and to be the source of traditional legends of the great event.

Of course, Dr. Prestwich takes cognisance of only such purely natural features and incidents as are mentioned in the Hebrew and Chaldean legends of the "Deluge," when he refers to these in connection with his subject. He does not find it necessary to allude to other legends; and he leaves it for others to trace the origin of such legends, whether in distant parts of the earth or nearer home.

This little book of well-digested knowledge will certainly produce good results towards a clearing away of old-fashioned, fanciful, mystical, and non-natural ideas about any so-called "Universal Deluge." It gives a good geological standpoint for the consideration of a diluvial catastrophe, of limited extent, in South-European, and probably West-Asiatic, regions, which must have occurred since Man began to inhabit this part of the World.

T. Rupert Jones.

The Life of the Broads.

Birds, Beasts, and Fishes of the Norfolk Broadland. By P. H. Emerson. Illustrated with sixty-eight photographs, by T. A. Cotton. 8vo. Pp. i.-xix., 1-396. London: David Nutt. Price 15s.

The Eastern counties are so famous for the visits which they receive from rare birds, that we turned with an unusually keen anticipation of enjoyment to the neat and attractive volume now before us. Indeed, the prospectus of the work promised a large amount of novel information, though we cannot discover that the promise has been fulfilled. Mr. Emerson comes before us in the *rôle* of a new writer on natural history, a capacity in which his name will of course be strange to ornithologists. He appears to aspire to belong to that modern school of writers of which Mr. Warde Fowler and the Son of the Marshes are the best known exponents. These gentlemen write for the many, rather than for the scientific few, and their lack of profound originality is much more than compensated for by the rich eloquence in which their finest thoughts are clothed. It would be difficult to over-estimate the importance of these cultured and æsthetic writers, who bring before us the sights and sounds of Nature in graceful and polished periods. Mr. Emerson's writings likewise possess the charm which is born of artistic perception. He is able to *idealise* the common facts of natural history which have come under his notice, and there can be no doubt that, so far as a limited experience carries him, he does his best to reproduce for us whatever he has hitherto learnt in his field rambles. Before we proceed further, it is only right to warn the reader that Mr. Emerson's writing possesses one great defect. He is far too self-conscious. He seems to be ever playing to the gallery, and anticipating the applause of the gods. This unpleasant feature is accentuated by the censorious tone which Mr. Emerson has found it necessary to adopt. At the first start he falls foul of the work of the best avian artists in Great Britain. "The monstrous and gaudy decorations of Selby, Gould, Dresser, and the illustrations to Booth's 'Rough Notes,'" make our experienced author "gasp for breath"; albeit, they contain much of the best work of such brilliant artists as Neale and Keulemans.

"Any marshman can point out the glaring errors of the meretricious and false woodcuts illustrating Yarrell and Saunders." As a matter of fact, Mr. Saunders' "Manual of British Birds" is embellished with some beautiful little woodcuts by a no less talented draughtsman than Mr. G. E. Lodge, whose cuts of the barred warbler and goshawk were directly based on living birds. A little further on, Mr. Emerson exposes the superficiality of "the Son of the Marshes," "whose writings possess but little artistic charm" (*sic*). Nor is he content with informing us that Mr. Saunders' manual is 'cataloguy' [whatever that may mean], and "far from lucid." He soon finds fault with the writings of those who have, alas! joined the majority, and can no longer splinter a lance in self-defence. Poor Richard Jefferies "did not know summer from spring," and his natural history notes have been discovered by our new prophet to be "inaccurate." We admit that Jefferies had no more claim than Mr. Emerson himself to be considered a scientific naturalist; but Mr. Stevenson belonged to the first rank of British ornithologists. We are gravely informed that Mr. Stevenson "did not know intimately the outdoor life of the birds he wrote about from personal observation!" It was reserved for Mr. Emerson to expose the "inartistic nature" of the accomplished man whom all his contemporaries delighted to honour; he has also detected the worthlessness of Mr. Stevenson's "pseudo-poetical vein." The truth seems to be that Mr. Emerson is an accomplished egotist, and will have us measure all other naturalists by his own high standard of merit. Nor must we forget to inform the readers of this notice, that though Mr. Emerson bases his text professedly on his personal observations alone, in sober truth most of the more noteworthy accounts of Norfolk birds were supplied to him by humble marshmen, whose valuable experiences are a marked feature of this book. Having thus drawn attention to the points upon which Mr. Emerson has gone out of the way to court unfavourable criticism, we have much pleasure in commending the dainty essays on feathers, fur, and scales, which make up our author's zoological treatise. If Mr. Emerson could be persuaded to leave alone the beam which he thinks he sees in his neighbour's eye, and to polish up his prose a little more—for it is not always either lucid or grammatical—we feel sure that his poetic fancies would find a large number of admirers. Mr. Emerson knows how to observe the wild creatures of the fens, and his criticisms are generally based upon reflection. For example, his remarks upon the habits of the rook (*Corvus frugilegus*), though they may contain no new facts, yet state the facts already familiar to practical men with praiseworthy accuracy. And the more we read, the more favourably we are impressed. Whether Mr. Emerson thinks fit to discourse upon pheasants or rats or eels, his freshness and vivacity are equally reliable, and cannot fail to afford great enjoyment to him who reads. It is true that these pages lack much of novelty. Mr. Emerson has seen the Great Reed Warbler in Norfolk. He even asserts that he has seen the Desert Wheatear, though as to that we must beg to register a verdict of "not proven," for we do not understand that Mr. Emerson has studied ornithology across the seas; rare wheatears are not to be identified at a glance even by experts, certainly not by amateurs. Some of his essays are rather meagre; that, for example, in which he informs us that "the goldfinch, or 'draw-water,' is not a bird of graceful build nor sweet song, yet is he dear to the Philistine, who loves variegated colours, because he satisfies a rude barbaric taste for colour; for he is a 'gay bird,' and he is great at parlour tricks, like his lover; for

cannot he draw his water and seed to his cage by a simple mechanical contrivance? and so he delights the populace as do the performing elephant and the contortionist." This is poor stuff, and unattractive. But such passages are the exception. The account of the author's *rencontre* with an osprey, given at p. 192, is perfectly delightful, and may be read with pleasure many times. Here, too, is a pretty little idyll of the ringed plover. "In April, as you walk by the sea, bordered by the shifting sand dunes, fringed with marram, fortalices that protect the flat land from the sea, you will come across these birds feeding in the pools left by the tide on the shifting shore; and if you leave the beach and wander over to wind-sculptured galleries, decorated with dry marram roots, you may in some cosy hollow, where the gravel lies thick upon thorn bushes, come upon the ringed plover's eggs, placed on the finer stones. There are generally three of these eggs [this is not our experience], and they are difficult to see, even when pointed out to you by more experienced eyes; but nowhere are they common in this district. You will always, too, find a bit of seaweed near the eggs. Later in the year, too, when the marsh-mowers' voices sound over the sand-hills, you may find the stone runner's eggs, for they rear two broods in a season. As the sun gains power, and the bright hot days of July beat down upon the gleaming sand-hills, you will, as you wander by the marram-fringed sea, come across little flocks of these pretty birds flying from pool to pool feeding, calling as they rise and fly down the beach before you, alighting fanwise on the yellow sands. That is the time to shoot them, for they make a capital dish, and taste nearly as sweet as a snipe (p. 268)." Before we take leave of our author, mention must be made of the numerous illustrations which have been so happily devised to secure the popularity of this dainty book. Personally, we must confess to a preference for the tiny vignettes of birds' nests, many of them based on photographs taken *in situ*; they have been selected judiciously, and are fairly distinct in detail. The full-page plates are less satisfactory, being based apparently on photographs of *stuffed* birds; but with the exception of the sand grouse (a bird which our author has never seen in life, and had better by far have omitted from his text), they are certain to be received with favour. H. A. Macpherson.

Plankton Studies on Lake Mendota.

The Vertical Distribution of the Pelagic Crustacea during July, 1894. E. A. Birge, Professor of Zoology, University of Wisconsin, assisted by O. A. Olson and H. P. Harder. From the *Transactions of the Wisconsin Academy of Sciences, Arts, and Letters*, vol. x. Issued June, 1895.

This is an elaborate report on a laborious experiment. Lake Mendota, in Wisconsin, has an extent of about six miles by four, with a greatest depth of about eighty feet. Of the crustacea captured during July, nearly two-thirds consisted of *Diaptomus oregonensis*, Lilljeborg. Three species of *Cyclops* supplied nearly one-third, and the balance was made up by two species of *Daphnia* (curiously distinct in vertical distribution) and one or two other entomostraca. Nearly 50 per cent. of the whole number were taken in the first ten feet from the surface, 30 per cent. in the second ten, and over 15 per cent. in the third, leaving a scattered few for the remaining depths. In October, however, "as soon as the temperature of the lake became uniform from top to bottom, the crustacea became pretty uniformly distributed, showing an arrangement wholly

different from that of the summer months." The predominant crustacea also varies with the time of year.

In Bohemia, at Lake Balaton, which is about thirty-six feet deep, "Francé found that the Plankton animals come by night to the surface, begin to descend at dawn to the deeper regions, remain there until early in the afternoon, when they begin to re-ascend, suddenly appear at the surface shortly after sunset, and there remain overnight." "His view is that the animals seek the cooler waters." But at Lake Mendota "there is practically no diurnal movement of the crustacea, or, if any, it is downward by night and upward by day," and Dr. Otto Zacharias is quoted as announcing, from observations made in the middle of September at Plön in Holstein, that the plankton of that lake shows no diurnal movement.

Other statements may be adduced which show that the subject is not a little complicated. Thus, de Guèrne and Richard, writing in 1889 on the freshwater Calanidæ, say, "it is certain that various types, *Diaptomus graciloides*, for example, are met with at the surface as well by day as by night; others, such as *Heterocope saliens*, have been found much more abundant by night than by day; but these are only isolated cases, to be explained, perhaps, by special circumstances (the search for food, etc.)." They note that *Limnocalanus macrurus* lives generally in the cold waters of the bottom of the great lakes, yet that specimens have been taken out in the daytime at the surface in the Gulf of Bothnia. Giesbrecht finds that in the Gulf of Naples the Copepoda are abundant at the surface in winter and scarce in summer, most of them at the latter season descending into deep water, though a few species swarm at the top. He is inclined to suppose that the diurnal migrations of pelagic animals take place under the influence of light, the annual under the influence of temperature.

To the report on Lake Mendota, ample as it is, some additions would still be of advantage. The temperature of the water in July is given only for the surface, and not for the lower levels. The ingenious dredge employed could only be used vertically. It is probable, therefore, that the actual floor of the lake was not explored, as that could scarcely be effected except by horizontal dredging. The observers do not appear to have noted whether the specimens, from whatever level they came, were, as a rule, captured alive. Nothing is said of the enemies to which the various crustacea are exposed at each or every season in this particular lake. In various waters the conditions of safety, comfort, and food-supply must be so diversely combined for the several species that the habits of many are likely to vary more or less according to the place of abode, as well as according to the time of year. For determining such questions numerous observations are needed, and it must be allowed that Professor Birge and his friends have made a highly useful contribution towards the required series. T. R. R. STEBBING.

BRITISH MOTHS.

THE LEPIDOPTERA OF THE BRITISH ISLANDS. By Charles G. Barrett, F.E.S. Vol. ii. (4 parts). Heterocera, Sphinges, Bombyces. 8vo. Pp. 372. London: L. Reeve & Co, 1895. Large paper edition with coloured plates (41-86). Price each part, 3s. plain, 5s. coloured.

JUST two years have passed since the first volume of Mr. Barrett's work, dealing with the British butterflies, was noticed in our pages. The present volume contains the first instalment of the moths. A

hundred and eighty species are dealt with in the two volumes, so it is evident that the rate of publication must be considerably accelerated if the two thousand or so British Lepidoptera are to be described within a reasonable time.

The families of moths included in this volume are the Sphingidæ, Sesiidæ, Zygænidæ, Zeuzeridæ, Hepialidæ, Cochliopodidæ, Chloephoridæ (Nycteolidæ), Nolidæ, Lithosiidæ, Arctiidæ, Liparidæ, and Psychidæ. According to the time-honoured arrangement of our British lists, the first three are united as "Sphinges," and the rest are called "Bombyces," though some other families usually included under the latter term—the Lasiocampidæ, Endromidæ, Saturniidæ, etc., are not comprised in this volume. We believe that they will be dealt with in the next. It is high time, however, that these misleading group-terms, Sphinges and Bombyces, were dropped from zoological literature. The three families included under the first name have nothing in common except their tapering antennæ, and, as Mr. Hampson has recently shown, the Sphingidæ on the one hand, and the Sesiidæ and Zygænidæ on the other, should stand almost at opposite ends in a series of Lepidoptera approaching a natural ideal. The "Bombyces" are a still more heterogeneous group, and Mr. Barrett, though he considers the term "very convenient," is unable to furnish a single definite character by which a moth referable to it may be recognised. A concurrence of imaginal and pupal structure points out the first three and the last of the "Bombycine" families, as given here, to be much nearer to the so-called "Microlepidoptera" than to the other "Bombyces." On several pages of the volume Mr. Barrett, indeed, mentions Dr. Chapman's recent comparisons of lepidopterous pupæ as throwing light on the true relationship between the families, but he remarks that to deal at length with the subject "would occupy far too much space in a work such as the present." We cannot by any means agree with this opinion. In such a book, which will be, when completed, a standard for reference by the vast company of British naturalists who collect butterflies and moths, it seems most desirable that the classification should be arranged on the most correctly scientific lines with which recent research has furnished us. Space devoted to the consideration of the true affinities of the insects collected would surely be of value to the collector, and might lead him to use part of his material in some worthy morphological inquiry. The peculiar habit of many lepidopterists of speaking of their favourite insects by the specific name only—"*convolvuli*," "*caia*," etc.—betrays an exclusive attention to species to the neglect of the more comprehensive divisions, which is responsible for the antiquated sequence with which these naturalists have been so long contented, and which, we regret to think, Mr. Barrett's book will still perpetuate.

There are no synoptic tables of families, genera, or (except in a very few cases) of species; the lack of these will seriously detract from the value of the book for the elementary student, especially in the edition without plates. A novice wishing to make out a moth new to him, would have to read through the descriptions of all the families, then those of all the genera of a family, and, lastly, those of all the species of a genus, a task which it would require no small patience to bring to a successful issue. The advanced worker, on the other hand, will not need Mr. Barrett's detailed descriptions of the species. Careful and accurate as these are, we would gladly have exchanged them for some remarks on modern classification and a reliable set of synopses.

In addition to the detailed descriptions of the moths, just referred

to, Mr. Barrett gives much valuable information on the variation which each species exhibits. Some very beautiful and striking forms are described and figured, and we are grateful to Mr. Barrett for not having thought it necessary to give to each a special name. As in the first volume, the facts of variation alone are noticed, theories as to the cause thereof being severely left alone. The preparatory stages of each insect are also carefully described, while the habits of caterpillar and moth are fully set forth with the detail to be expected from so experienced a collector and observer as our author. The British localities for each species appear to have been compiled with much care, and the difficulty of making such information reliable is rendered very great by the vast number of records which are scattered through our entomological magazines, and the untrustworthy nature of a not inconsiderable minority of them. Mr. Barrett seems to have well sifted doubtful captures, and his long experience of moths and those who catch and sell them renders his opinion on such subjects of much value. The pages of his book will furnish a storehouse of facts for students of the range of species within the British Islands, and we are very glad to notice that the insular distribution is supplemented by a summary of the general distribution of each insect. It is sad to read of the restriction of range or total extinction undergone by some rare species, it is to be feared from the greed of collectors. *Lælia cænosa* has apparently disappeared from our fauna, and *Ocneria dispar* has only been preserved in a domesticated condition by rearing the larva through many generations. Some solace for these losses is afforded by the recent immigration of *Callimorpha hera* into Devonshire, where this beautiful moth has apparently established itself without artificial help.

With regard to specific names, Mr. Barrett gives, in equally conspicuous type, both those of the Doubleday list, so familiar to the older British lepidopterists, and those of the Staudinger Catalogue, used in Mr. South's later list. As the Doubleday name in each instance stands first, we presume that is preferred by the author. In the introduction (in vol. i.) Mr. Barrett deliberately declines to settle the competing claims of the various names in use. We rather regret this, as any objection he might have to the generally accepted names of the Staudinger Catalogue would be undoubtedly worth consideration, while if there be no valid objection to them, it is very undesirable to perpetuate differences of specific nomenclature between British and Continental naturalists. In generic nomenclature, uniformity is of course impossible, unless the value of generic divisions can be agreed upon. We would only point out that the name *Liparis*, which has so long been familiar as the type genus of the "Tussocks," properly belongs to a fish. In Mr. Kirby's recent "Catalogue" it is replaced by *Lymantria*, and the family name should, of course, be changed too.

The coloured plates which accompany the large paper edition are good. Presumably on account of the issue of the work in the two forms, there is no reference whatever to them in the text, an omission which certainly diminishes their usefulness. Nor does even an advertisement in the plain edition (which alone we have received for review) give any hint of their existence. But for our power of access to a library where the larger edition has been taken in, we should have been debarred from the pleasure of mentioning them.

While, therefore, the method in which the larger aspects of the subject are dealt with by Mr. Barrett leaves much to be desired, his work must prove a most valuable book of reference for all interested

in the problems of migration, distribution, variation, and habits presented by the best known group in our insect fauna. The labour involved in such an undertaking as this is immense. We heartily congratulate the author on the progress which he has made, and hope we may see the succeeding volumes appear at less distant intervals than that which has elapsed since we had the pleasure of noticing the first.

Outlines of Zoology.

Outlines of Zoology. By J. Arthur Thomson, M.A., F.R.S.E. Second Edition revised and enlarged with 266 illustrations. Pp. 820. Edinburgh and London: Young J. Pentland, 1895.

The second edition of Mr. Thomson's text-book from the outset impresses itself on one more favourably than the first. For the illustrations have been greatly improved; many new drawings have been added and they appear in the text in their appropriate places. Some of them are still inadequate. Thus, in the transverse section of the earthworm, the cœlomic epithelium is omitted; the mass of chloragogenous cells in which the dorsal blood-vessel is embedded is exhibited as a mysterious, unnamed structure, different in appearance from the similar cells surrounding the intestine; the nephridia are omitted entirely and they are not figured elsewhere. Again, in the drawing of the reproductive organs of the same animal (after Hering) the ovaries are incorrectly represented. In the figures of the urino-genital organs of the frog, the male represented is *Rana esculenta* and does not show the characteristic seminal vesicles which the student is bound to see in the *Rana temporaria* he is more likely to dissect; in the female, the ovaries are quite incorrectly represented; the characteristic plicated appearance of these, when they are not entirely obscured by a mass of discharged ova, is not shown. In the diagrams of the similar organs of the rabbit the uterus masculinus is not visible in the case of the male, while, in the female, the relations of the bladder to the uterus are quite inadequately represented. We have pointed out such slips perhaps more carefully than their intrinsic importance warrants; but they all relate to animals that a student is certain to dissect. And nothing is more harassing to a good student or more apt to harden the heart of a careless, than to find his dissections incongruous with the figures of his text-book.

For the rest we think Mr. Thomson's text-book one of great merit. It is weak in palæontology; but as practical palæontology hardly comes the way of the student, this matters less than in many books of wider aim. It is unusually and strikingly excellent in that it deals with the animals as living things as well as materials for the scalpel. To each section there are appended notes on what Professor Lankester has called bionomics, and many students, whom the details of anatomy would repel, may find that there are "observables" (to use the phrase of Robert Boyle) concerning animals as interesting, and, from the point of view of abstract knowledge as important, as laboratory work.

From one point of view, however, we have something to say against the book. To a certain extent it is based upon the Scotch courses of natural history. These, in the brave days of old, before modern science had been developed into its present encyclopædic character, were designed to impart to the perfervid talent of Scotch youth a complete account of the natural world. They used to begin with cosmogonies and end with the marvels of design as exemplified in the structure of the human frame. Into this old bottle is poured

the new and full-bodied wine of modern biology. Consider Mr. Thomson's 820 pages, which will be absorbed, index and all, by many a gallant young Scot. Are you interested in karyokinesis and polar bodies? You will find an account of them here. Do problems of heredity absorb you? Here is Mr. Thomson with a table telling you what is to be inherited and what not; with an excursus upon germ-tracks and the early separation of sexual cells. Perhaps the origin of sex itself troubles your waking hours? Mr. Thomson presents you with a pemmican of himself and Professor Geddes. You are a student of variation? Mr. Thomson has a table for you. Or an organic chemist? Read Mr. Thomson upon Lipochrome and Zoonerythrin. Or, excited by the "Challenger" number of Natural Science, you would know about Plankton and Nekton? Mr. Thomson has discussions and diagrams, admirable and up-to-date. Or is it the grander problems of evolution? Consult the last chapter and bend over the many-twigged tree on page 2. Would you know about physiology? Here is one whole chapter and a half chapter on that neglected subject, Comparative Physiology. Are you a pathologist? Mr. Thomson is ready for you with half a chapter. And the whole book deals with comparative anatomy and embryology, not omitting the relations of *Rhabdopleura* and *Cephalodiscus*, the relation of ganoids to teleosteans, the morphology of the auditory ossicles, the pedigree of cœlenterata, the nephridia of amphioxus, the larval twisting of the same animal, the pineal eye and the homologies of the cranial nerves.

Frankly, the thing is impossible. It would take not 820 pages but 820 volumes to deal with the mass of subject-matter represented in Mr. Thomson's book. It could have been written only by one of great knowledge and greater diligence: by one who has consulted the works of John Hunter and the latest issue of the *Jahresbericht*. But we would willingly take it for granted that Mr. Thomson knows more than any Scotch professor, or, for the matter of that, than any English, German, French, or Dutch professor, and we would have from his charming and luminous pen a volume of which the contents were more congruous with the bulk. P. C. M.

African Diseases.

On the Geographical Distribution of Tropical Diseases in Africa By R. W. Felkin. 8vo. Pp. 79, with folding table and map. Edinburgh: W. F. Clay. 1895. Price 3s. 6d. nett.

African diseases are now acquiring a somewhat extensive literature, which is, unfortunately, often as irritating as the diseases themselves. From Dr. Felkin we had expected something much better than the average, for he is a lecturer on tropical diseases at the Medical School of Edinburgh, and has had great experience and done most useful work in Equatorial Africa. There is, of course, no comparison between his book and such a production as Père Etterlé's "Les Maladies de l'Afrique Tropicale"; but still many unfortunate errors occur in it. Thus we are told that "the rainfall at the equator is pretty evenly distributed throughout the year," which is certainly not the case except locally; then the author informs us that the vegetation becomes generally richer, proceeding from west to east, which is, perhaps, a misprint for *vice versâ*. On p. 63 the Leprosy Commission is reported to have concluded that leprosy is neither contagious nor hereditary. On p. 78 the Cape is said to be free from malaria, and is so coloured on the map; whereas malaria of a very bad type is prevalent in some places, as at the back of Port Elizabeth.

Then it comes rather as a shock to read of an "*isobar* of 58°–60° F." (p. 70). The book is, moreover, not always up-to-date: thus the statement on p. 62, that the cause of elephantiasis is unknown, overlooks the work of Dr. Manson; while the conclusion on p. 34 that bilious remittent fever, blackwater fever, hæmaturia, endemic and typhomalarial fever are all "simply malarial fever distinguished by some prominent symptom," seems to us to be contrary to the latent evidence on the subject. In other cases the author's conclusions seem a little too previous. Thus on his map he leaves two blanks to the north-east of the Victoria Nyanza, thus indicating that they are free from malaria. Only one European expedition has been to one of these, and Count Teleki, its leader, nearly died of fever there. The other and larger oasis has been practically unvisited. A few men have crossed its southern margin and found that fever is exceptionally severe there. On p. 78 it is explained that malaria is reported to be absent from these areas "because the altitude—over 3,000 feet—is too great for its production." The author adds that this is a general statement, and that local conditions may modify it, but the results of recent investigations in German East Africa oppose it; and as the author colours as malarial nearly all the districts in Africa over 5,000 feet high, we do not quite understand how to reconcile his statement and his map.

The best part of the book is that between pages 51 and 75, in which short sketches are given of the principal diseases and the remedies recommended. The map is constructed on a new design, but as it is on too small a scale to show local conditions, its value is doubtful. Its topographical information is, moreover, not above suspicion, as when it runs a river from the southern end of the Albert to the Victoria Nyanza, and places Kavali on Tanganyika, instead of on the Albert Nyanza.

Botany for Teachers.

Object Lessons in Botany from Forest, Field, Wayside and Garden. Being a Teacher's aid to a systematic course of one hundred lessons for boys and girls. By Edward Snelgrove, B.A. Pp. 297, with 153 figures in the text. London: Jarrold & Sons (no date. Received June, 1895). Price 3s. 6d.

Mr. Snelgrove begins his book with a quotation from Natural Science, in which a reviewer insists that the most successful book for education or instruction will be that which "leads its readers along the same paths as the discoverers of the science must have followed." Facts must, as it were, be rediscovered, steps *made*, conclusions *drawn*, and definitions *led up to*. These ideals, says the author, have been before him in planning the object lessons. We congratulate him on their successful realisation. There is no dearth of elementary botanical books, but a really good one is a rarity. If the arrangement is satisfactory the text is often full of errors, or *vice versâ*. In the case before us, however, the writer has been careful as to facts, and there is no fault to be found with their arrangement. Plenty of fresh specimens of leaves, flowers, or fruits are given to the children, and they are led to make out for themselves, step by step, the points of interest. If the teacher carefully leads his little students according to the directions given he will ensure for them a very fair grounding in the first elements of botany, and also instil in them a love of plants and a longing to find out more and more about them. The book is divided into four sections. The first, on leaves, stems, and roots, is adapted for Standard III.; the second, on flowers, for Standard IV.;

and the third and fourth, on fruits and seeds and classification respectively, for the still more advanced Standard V.

The figures will be found useful as copies for blackboard elucidation of various structural points.

The Distribution of Plants.

Manuel de Géographie Botanique. Par le Dr. Oscar Drude traduit par Georges Poirault et revu et augmenté par l'auteur. Livraisons 4-5. Pp. 129-224. Paris: Klincksieck.

The date 1893 on the cover of the issue refers to the year in which the first part of this work appeared. It is a matter for regret that the succeeding parts, which were promised in rapid succession, should be so long delayed, as at the present rate the earlier pages will be antiquated ere livraison 12 or 13 reaches us. The work is a valuable one, and much needed, and it is to the interests of both translator and publisher to hasten its completion.

The 96 pages now in question are occupied with the completion of Part II. on plant areas, the whole of Part III. on the distribution of the chief plant groups in the various floral regions, with a note on distributional maps (pp. 140-197), and the commencement of Part IV. on the association of plant forms to give a botanical facies.

The Index to Periodicals.

Index to the Periodicals of 1894. By Miss E. Hetherington. Vol. v. 4to. Pp. x., 182. London: *Review of Reviews* Office, 1895. Printed by Mackay, Chatham. Price 5s. nett.

We have nothing but praise for this new volume. In the first-place, because it is as good as the last, and in the second, because it is much better, and shows the steady improvement that finally ends in perfection. Now we possess our yearly index it is somewhat singular that we managed to do so long without it. It is pleasing to gather from Mr. Stead's opening sentence that the work is not a failure from the public point of view; but the sale needs to be very large to repay the outlay.

It is well to insist at once that this is not a mere reprint of the monthly lists issued with the *Review of Reviews*, nor is it in any way compiled from those lists, but is an entirely separate publication, separately compiled under Miss Hetherington's direction. This year new journals are included, and practically everything that is of any use to anybody is catalogued. The value of such a list as this is extraordinary. The public can find by a mere reference the latest views on the most diverse subjects, as, for instance, geology (160 entries), Egyptology, marriage, lunacy, scorpions, wills, savings banks, bacteriology, and bagpipes. A rigid line is drawn at newspapers, and one not quite so rigid at publications of learned societies. These two sections are, however, so perfectly distinct from periodicals that the rejection is a wise one. The guide to the periodical literature of the world, which appeared in vol. iv., has been omitted, as it would have been a pity to occupy space with a mere reprint, and the headings have been printed in black type, a great improvement on previous issues. No library can possibly afford to do without this patiently and industriously compiled volume, and the individual who has once bought a copy will purchase all the rest. To compile such a list of literature and issue it only six months after date is a feat of which anyone might be proud, and we congratulate Miss Hetherington on her judgment and success.

OBITUARY.

CHARLES CARDALE BABINGTON.

THE late Cambridge Professor of Botany was born November 23, 1808, at Ludlow, becoming in due course a student at St. John's College, Cambridge, and in 1861 succeeding Professor Henslow in the chair of botany at the University. Though he retained this professorship till his death, on July 22, it is many years since he took any active part in the work of the botanical school, which was, however, raised to a high standard of efficiency by Dr. Vines' efforts, and now flourishes under the direction of the deputy-professor, Mr. F. Darwin. Babington's chief work was on our native flora and its relations, and found its expression in his "Manual of British Botany," the first edition of which appeared in 1843, and the eighth in 1881. For the discrimination of plants, especially of the more critical species, it is unequalled. In connection with his work on the British Flora he devoted much time and care to the elucidation of the Brambles, his "British Rubi," an octavo of more than 300 pages, appearing in 1869. To him we also owe a useful "Flora of Cambridgeshire," published in 1860. In 1846 he visited Iceland, and on his return communicated a list of the plants gathered to the *Transactions of the Edinburgh Botanical Society* (vol. iii.); in 1871 his revision of the flora of the island appeared in the *Journal of the Linnean Society*; localities are given for 467 species of flowering plants and ferns. He also published a large number of separate papers on the botany of Great Britain with Ireland and the Channel Islands, which will be found in the publications of the Linnean Society, the *Journal of Botany*, the *Annals and Magazine of Natural History*, the Edinburgh Botanical Society's *Transactions*, Henfrey's *Botanical Gazette*, and elsewhere. Their number in the Royal Society's Catalogue reaches 131. The "law of priority in nomenclature" even provoked a letter from him to the *Journal of Botany* (1864, p. 94). British insects formed another subject of interest to Babington, and several papers on them will be found in the Entomological Society's *Transactions* and other journals devoted to this branch.

It is evident that the professor's life had been a busy one; his energies, moreover, were not used up by scientific work, for he was well-known in the neighbourhood of Cambridge in connection with philanthropic undertakings. He died on July 22nd.

JOSEPH THOMSON.

Born February 2, 1858. Died August 2, 1895.

THE death of Joseph Thomson adds another name to the list of those who have perished in the exploration of Africa. He was born near Dumfries, studied at Edinburgh University, and at the age of twenty-one years accompanied Keith Johnston's expedition to the Great Lakes. This expedition he successfully carried through, despite the fact that the leader died soon after leaving the coast. His second expedition was one in search of coal, in 1881, to the Rovuma Valley, and his third and most important was the exploration of Masailand, a district inhabited by natives of a particularly dangerous character. But Thomson's tact and patience carried the day, and he was able, by advance and retreat, eventually to reach Barengo Lake, though he had to relinquish a projected visit to Mt. Kenya. In 1885 he entered the Royal Niger Company's service, and concluded various treaties in the Central Soudan, while in 1891 the South Africa Company enlisted his services for an exploration of the Nyasa and Bangweolo region. But his health gave way, and the disease to which he ultimately succumbed was contracted during this period. Mr. Thomson's best known books are "Through Masai Land" (1885); "To the Central African Lakes and Back" (1881); and a "Life of Mungo Park" (1890).

DANIEL CADY EATON.

PROFESSOR EATON died at New Haven, U.S.A., on June 29, in the sixty-first year of his age. For more than thirty years he had held the chair of botany in Yale College, where he previously graduated in 1857. After leaving college he had the advantage of three years' study under Dr. Gray at Harvard. He was the recognised authority in the United States on ferns and fern allies, and supplied the account of these groups for Chapman's "Flora of the Southern United States," Gray's "Manual of Botany" (fifth edition), and Gray's "Botany of Field, Forest, and Garden." His most important work was that on the "Ferns, which appeared in 1879–80, including the Ophioglossaceæ of the United States of America and British North American Possessions," illustrated with coloured plates. He was also the author of numerous other papers, many of which relate to his special group. Professor Eaton inherited a taste for botany, his grandfather, Professor Amos Eaton, being one of the leading systematic botanists of his day, while his father, General Amos B. Eaton, was also given to scientific research.

For several of the facts mentioned in this notice we are indebted to *Garden and Forest*, of which the issue for July 10 gives an appreciative account of Professor Eaton's work and character.

JOSEPH GRANVILLE NORWOOD.

Born December 20, 1807. Died May 6, 1895.

ONE of the last of the older American school of geologists and palæontologists has passed away in the person of Mr. J. G. Norwood. He was born in Woodford County, Kentucky, educated in local schools, and entered a printing office, shortly after publishing a newspaper, a medical journal, and other matters. About 1832 he left business for the pursuit of medicine, and quickly gaining his diploma, secured a large general practice by the end of 1835. His medical career continued till 1847, when he was urged to enter the U.S. Geological Survey. From 1847–1851 he was assistant geologist with David Dale Owen on the survey of Wisconsin, Iowa, and Minnesota; from 1851–1858, State Geologist of Illinois; while from 1858–1860, assistant geologist of Missouri. From 1860–1880 he was Professor in the University of the State of Missouri, holding the chairs of Geology and Chemistry, and in 1871 he held the office of State Geologist of Missouri for a few months, till a person was definitely appointed.

His chief works are "Researches among the Protozoic and Carboniferous Rocks of Central Kentucky," which he published in conjunction with D. D. Owen in 1847; "Geological Report of a Survey of a Portion of Wisconsin and Minnesota," and two "Reports of Progress" while State Geologist of Illinois. Dr. Norwood died at Columbia, Missouri, and we are indebted to an article, with a portrait, in the *American Geologist* for the above particulars of his life.

FREDERICK KITTON.

Born 1826. Died July 22, 1895.

ALL students of Diatomaceæ will learn with regret of the death of Mr. Kitton, who was, we believe, born at Cambridge. He settled in Norwich about forty years ago as a retail trader, but his shop became a rendezvous for men of scientific interests, similar to that of John Morris and the London Clay Club. Kitton worked hard at his favourite subject, and made numerous discoveries, many of which were named after him. He was a frequent contributor to the *Microscopical Journal* and the *Quarterly Journal of Microscopical Science*, and his more recent labour is well-known to our readers as a "Challenger" Report, which he produced in company with Count Castracane. Apart from his science, Kitton had acquired a mastery over Anglo-Saxon, and in 1883 he prepared a catalogue of the Library of the City of Norwich. His eldest son, Mr. F. G. Kitton, is known as the successful authority on the life and portraits of Charles Dickens.

GUSTAV VON NORDENSKIÖLD.

IT is with great regret that we record the death of Gustav von Nordenskiöld, which occurred at Stockholm on June 26 last from consumption, at the early age of twenty-seven. He was an explorer and observer of considerable merit, as may be gathered from his magnificent work on the cliff-dwellers of Mexico, his exploration of Spitzbergen, and his investigation of the minute structure of snow crystals, which was beautifully illustrated by photographs taken by himself. Unfortunately, his early death deprives the Swedes of an intrepid leader in their projected Antarctic expedition.

THE terribly sudden death of Mr. FRANCIS E. BROWN, the energetic and accomplished clerk to the Geological Society of London, has robbed that Society of a man whose tact and resourcefulness had often proved valuable. Mr. Brown died on August 2, at Shepherd's Bush, from the breaking of a blood-vessel. His good nature and courtesy had endeared him to the fellows, many of whom feel that they have lost a personal friend.

AMONG other deaths which it is our misfortune to chronicle, are those of JULIEN DEBY, the eminent diatomist, whose collections were recently acquired by the British Museum; Professor P. A. S. VERNEUIL, the surgeon, who died at Paris on July 12, aged 71; Dr. GEORGE MARX, archæologist and entomologist to the U.S. Department of Agriculture, whose death occurred at Washington on January 3; H. WITMEUR, Professor of Geology and Mineralogy in the Brussels University; Sir JOHN TOMES, the dental physiologist and surgeon, who passed away at Caterham on July 29, aged 80. Dr. HERMANN KNOBLAUCH, the distinguished head of the K. Leopoldinisch-Carolinische Academie of Halle, died on June 30, aged 76; ISAAC SPRAGUE, the botanist, at Wellesley Hills, Mass., on March 15 last; Professor PELLEGRINO STROBEL, the geologist and conchologist of Parma, on June 9; C. E. ADOLF GERSTAECKER, Professor of Zoology in Greifswald University, on July 20; Dr. W. Voss, the mycologist, recently at Vienna; Dr. R. PECK, Director of the Natural History Museum at Görlitz; Dr. NORTON S. TOWNSHEND, Professor of Agriculture in the Ohio University, at the age of 79; and ERNST HENRI BAILLON, the eminent botanist, an obituary notice of whom we shall endeavour to print next month.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

The following appointments have recently been made: G. S. Corstorphine, as assistant in charge of fossils and minerals in the S. African Museum. He has begun by reporting on the meagre state of the collections and their want of arrangement. Dr. Carl Barus as Hazard Professor of Physics in Brown University; J. H. Tyrrell, to be Professor of Geology and Mineralogy in Toronto University; H. F. Bain, as Assistant State Geologist to the Iowa Geological Survey, succeeding Dr. Keyes, who becomes State Geologist of Missouri; C. P. Sigerfoos, as assistant in charge of the Marine Laboratory of the Johns Hopkins University, to be stationed at Beaufort, N.C., during the summer of 1895; Messrs. A. L. Lamb and H. L. Clark, to occupy the Johns Hopkins table in the U.S. Fish Commission Laboratory at Woods' Holl during the present summer; Dr. Beyschlag and Dr. Th. Ebert, to the Berlin Geological Survey; Dr. Reinitzer, of Prague, as Professor of Botany at Graz University; Dr. Robert Scheibe and Dr. Fritz Köller, as Professors in the Bergakademie of Berlin; Dr. Rex and Dr. Steinbach, as assistant Professors of Anatomy and Physiology in Prague University; Dr. A. Rolossov, as Professor of Histology and Embryology in Warsaw University; Dr. Franklin Dexter, as assistant Professor of Anatomy at Harvard Medical School; Dr. Alfred Schaper, of Zürich, as Demonstrator of Histology and Embryology at the same place. Dr. J. Buchwald, of Berlin, has been placed in charge of the Botanico-Agricultural Station founded at Usambara in German East Africa; Professor Church and Dr. Fream have been appointed Honorary Professors at the Royal Agricultural College of Cirencester; and Dr. H. Lenk, Professor of Geology at Leipzig University.

The *South African Review* states that Roland Trimen has resigned his position as Curator of the South African Museum, and is returning to England.

Professor J. W. Judd has received the honour of C.B., and has been appointed by the Lord President of the Council to succeed the late Professor Huxley as Dean of the Royal College of Science.

Dr. Rudolf S. Bergh, the eminent Danish zoologist, has been elected corresponding member of the French Academy of Sciences, in the room of the late Professor Huxley; Professor Sir William Flower, a correspondent in the Section of Anatomy and Zoology, in the place of M. van Beneden; Professor Ferdinand Cohn, a correspondent in Botany, to the chair vacated by the death of the Marquis de Saporta; and Professor G. Retzius as a correspondent in Anatomy and Zoology, in the room of Carl Vogt, deceased.

It is proposed to celebrate in December next the fiftieth anniversary of the doctorate of Dr. Rudolph Leuckart. A bust of the eminent zoologist is suggested, and Dr. Carl Graubner, 8, Johannesgasse, Leipzig, is empowered to receive the names of those who desire to honour the Professor. Professor Sir Joseph Lister is to be similarly honoured, as a number of his colleagues intend to offer a portrait of the great surgeon to the Royal College of Surgeons, to be placed side by side with that of John Hunter and other benefactors of the human race.

THE men of science who have entered the lists as candidates for Parliament in the recent elections have not on the whole been especially successful. Sir John Lubbock returns to represent his old constituency of the University of London, though after an unfortunate wrangle with some of the supporters of the Gresham Scheme, who, perhaps, have not sufficiently allowed for the fact that an election address is an election address. Sir John Colomb will be welcomed back, thanks to Yarmouth, and Sir Henry Howorth has retained his seat.

The losses, however, have been serious. Chief among these is that of Sir Henry Roscoe. Geographers will regret the failure of Major Darwin to hold the seat he rather unexpectedly won in 1892; they will, however, be glad of the success of Mr. Stanley. African problems seem destined to come much to the front during the next few years, and so much ignorance of the subject was shown in last session's debates that Mr. Stanley ought to prove one of the most useful of the new members. Sir E. J. Reed's defeat at Cardiff is a serious loss to the interests of mechanical science, which has lost another representative in the defeat of Mr. Moulton.

THE Institute of France will celebrate its centenary in October. The occasion will be marked by a series of fêtes and receptions, followed by a banquet on October 25; the Comédie Française will give a special performance, and the President of the French a special reception. A visit to Chantilly will conclude the observances.

THE Senate of the Smithsonian Institution has voted the Hodgkins prize of 10,000 dollars, in equal proportions, to Lord Rayleigh and Professor Ramsay, in recognition of their discovery of argon. One thousand dollars has also been voted by the same body to H. de Varigny, of Paris, for the best popular essay on the properties of the atmosphere.

THE attendance at the British Museum (Natural History) during 1894 numbered 413,572, showing an excess of over 5,000 on the previous year. This gives a daily average of about 1,300. We learn that the construction of a special gallery for Cetacea is now in progress, the foundations having already been laid down.

THE Royal Society will continue to issue its *Philosophical Transactions* in the present quarto form, but they have resolved to alter the size of the *Proceedings* to that of royal octavo, a change to be made at some early convenient time.

THE State of New York has set aside 16,000 dollars to be spent, under the direction of Professor L. H. Bailey, of Cornell University, in experiments in horticulture, the remedy of plant-diseases, and similar objects. The work, which should yield results of value to the botanist as well as to the cultivator, is to be confined to the fruit-growing region of western New York, north and west of Lake Cayuga.

ACCORDING to the report read on August 10 before the annual meeting of the Royal Botanic Society, the opening of the grounds, even to a paying public, has its disadvantages. The admission of the public to a gardens, even by payment, entails the employment of a large additional staff to collect the litter made by the elders, and to check the damage done by children to flowers and shrubs. It seems singular that those who can afford to pay 6d. or 1s. for a pleasure have not, as a body, sufficient intelligence to conduct themselves properly, or to prevent their children from injuring property. It is, however, to be hoped that the Society will see its way to continue its policy, for after a while the rush of idle sightseers will pass, and a steady, though perhaps small, income may be derived from those who really desire to visit the Botanic Gardens for the love of its beauties.

THE collections of Dr. F. Stephani, consisting of 10,000 specimens of Hepatics, including his types, have been acquired by the British Museum. The Paris

Museum has received a further collection of birds from Mr. Adolphe Boucard. Dr. Jousseaume, who has lately returned from Obock, has placed his collections of mollusca, crustacea, and other marine animals at the disposal of the same Museum. Professor J. G. Agardh has presented his collection of algæ to the University of Lund.

THE Boston Society of Natural History offers two prizes, under the Walker Bequest, for original papers on "The Area of Some Foliated Rock in the United States," "A Study of some Appalachian Valley," "A Study of some Points in the Physiology of any Animal except Man," and "The Cross-Fertilisation of a Plant." These are for 1896. For 1897, the subjects are "Peculiar Phenomena associated with the close of the Glacial Epoch," "Chalazal Impregnation of any American Plant (*Angiosperms*)," "Contributions to the Knowledge of Bacteria," and "Experimental Investigation in Cytology." The prizes are of sixty and fifty dollars.

MR. SAMUEL CHADWICK, Honorary Curator of the Malton Museum since its foundation, has left Yorkshire for New Zealand, where he will for the future reside. The Malton Field Naturalists' Society held a special meeting on the 19th ult., under the presidency of Professor L. C. Miall, and presented him with a farewell address.

DURING the visit of the Geologists' Association to Co. Antrim, those members in Belfast had an opportunity of inspecting the fine collections made by Mr. Joseph Wright. These consist chiefly of Carboniferous and Cretaceous fossils, but the best things are to be found in Mr. Wright's collections of Chalk Foraminifera, which is probably unique. Mr. Elcock was also to be seen at Mr. Wright's, and his beautiful drawings of the microzoa largely assisted the interpretation of his friend's collections. The excursion was most successful, only one day of the six being wet. The members had an excellent opportunity of seeing the amount of damage done by the sea in a single storm (December, 1894), during the ride along the coast from Larne to Cushendall, and again at Ballycastle, Torr Head, and Murlough Bay. Mr. Alexander McHenry and Mr. Praeger conducted the excursion, which was arranged by Miss Thompson and the Belfast Club.

THE seventh meeting of the Australian Association for the Advancement of Science will be held from January 3-10, 1897, at Sydney, under the presidency of Professor Liversedge. Captain Hutton will preside over Geology; Professor T. J. Parker over Biology; Mr. H. S. W. Crummer over Geography; Mr. A. W. Howitt over Anthropology.

THE eleventh Congress of Americanists will meet at Mexico from the 15-20 October. Among the subjects interesting to readers of NATURAL SCIENCE, the following will be discussed:—Origin and progress of the Caribs; Different forms and uses of arrows among the Indians of Central America; Researches on the date of the first arrival of man in America; Relations between the Esquimaux and other indigenous races of North America; Prehistoric man in Mexico; Cliff dwellers. Letters should be addressed to Sr. Trinadad Sanchez Santos, Biblioteca Nacional, Mexico [D. F.]. The President will be Sr. Lic. Joaquin Baranda. The third International Congress of Agriculture will be held in Brussels from September 8 to 16; the second Italian Geographical Congress will be held in Rome at the end of the same month. Particulars of the latter can be obtained from the President, Via del Plebiscito 102, Rome. The third International Congress of Physiologists will be held at Berne, September 9 to 13.

AMONG the papers to be read at the third International Zoological Congress are the following:—A. Milne Edwards, on the resemblances between the fauna of the Madagascar group and that of certain islands in the Southern Pacific; A. Giard, on parasitic castration and Weismannism; A. Sedgwick, on cellular theories; V. Hensen, on his Plankton studies; Bowdler Sharpe, on the classification of birds;

N. Zograf, on the origin of the lacustrine fauna of European Russia; J. Büttikofer, on the fauna of Borneo; E. Dubois, on *Pithecanthropus;* W. Leche, on development of the teeth; N. Zograf, on the odontography of the chondrostoid Ganoids; R. Semon, on the embryology of the Vertebrata; C. W. Stiles, on the Cestodes of American rabbits; R. Blanchard, on the Leeches of the Netherland Indies and Indo-Malaya; S. J. Hickson, on the classification of the Alcyonaria; Selys-Longchamps, on the geographical distribution of the Odonata; E. Wasman, on the Myrmecophilæ; A. Fritze, on the season-dimorphism of the butterflies of Japan and the Liu-Kiu. Canestrini will discuss the Acari; Korotnev, the development of the Tunicates; E. Perrier, the classification of the worms; J. W. Spengel, new researches on *Enteropneustes;* Herdman, the Tunicates; and Weismann will give an opening address. Dr. Field's scheme for recording zoological literature will be fully discussed on the first day.

A scheme for a card catalogue of Scientific Literature has been described in *Science* for July 19, by Mr. F. B. Weeks. Mr. A. G. S. Josephson, of the Lennox Library, has a letter in the same publication advocating an International Congress of Bibliography.

We have received nos. 5 and 6 of the *Revista de la Facultad de Agronomia y Veterinaria*, of La Plata, which contains, among other matter, a paper on the external form of the horse, by Dr. G. J. Bernier, Professor to the Faculty. There is also an interesting paper on the agronomy of Parana by Professor Antonio Gil.

The *Zeitschrift für angewandte Mikroskopie* is a new octavo monthly of thirty-two pages, edited by G. Marpmann, published by R. Thost in Leipzig, Hospitalstrasse 10. It deals chiefly with the technique of microscopy, and partly with its scientific results. It contains original articles, reviews, notes and correspondence; and as a supplement is given a dictionary of terms that should be useful to English readers of German biological papers. The annual subscription is ten marks.

The *American Naturalist* has started a new section, "Vegetable Physiology," under the editorship of Dr. Edwin F. Smith. The *Botanical Gazette* pertinently remarks that the first article is on nomenclature, and has nothing particular to do with physiology.

A valuable atlas has just appeared in Penck's *Geographische Abhandlung*. It deals with the Austrian alpine lakes, and is the work of Penck and Richter. Contours are given of the lake depths and the heights of the land surrounding them. The work is similar in many respects to Geistbeck's "Seen der Deutschen Alpen," published by the *Vereins für Erdkunde* in Leipzig in 1885. Dr. Mill's work on the lakes of our own country is, of course, well known to all our readers.

In the *Quarterly Journal of the Geological Society* for August 1 will be found a full description of the human remains from Galley Hill, referred to in Natural Science for June last. There is also Dr. Gregory's paper on the Palæontology and Physical Geology of the West Indies, containing a detailed description of the corals of the Barbados reefs with a remarkable and important synonymy. This is clearly the most valuable portion of this section of the paper, and will help to clear up the mysteries of coral nomenclature to a large extent, and, although we cannot agree with him in the rejection of *Porites porites* (Linn.), he is justified in adhering to the British Association rule. Another paper, the importance of which it is hardly yet time to estimate, is Mr. Buckman's "Bajocian of the Mid-Cotteswolds."

Dr. Dörfler, of the Hof Museum, Vienna, is compiling a directory of botanists. He will be glad of information concerning names, addresses, and special subjects, as well as of gardens and institutions whose employés ought to appear in such a work. Address Burgring 7, Vienna, I.

CORRESPONDENCE.

Botany and the Science and Art Department.

Our reference to the Science and Art Department's examinations in botany in the August number of Natural Science has evoked more correspondence. If we accept the principle that, given endowments, examinations are necessary for their distribution, there will always be heartburnings and dissatisfaction at the results. On one point our correspondents all agree, and that is unless the plant given for description is correctly referred to the natural order, it is impossible to obtain a first class in either the advanced or honours stage. We can hardly believe that the mere "spotting" of a plant can make all this difference, though the candidates' evidence certainly points in that direction. We presume students understand that a much higher standard is required for the attainment of a first than of a second class; but we must assume that the standard is one of general proficiency, and not dependent on an almost unattainable excellence in one branch. For such would be the case according to a candidate for honours last May, who, having been sorely puzzled by the specimen given for description, made a point of asking the examiner, during the practical examination, the name of the order to which the plant really belonged. "The examiner then acknowledged that the plant was a very difficult one, and that not one candidate had referred it correctly!—the majority referring it to Scrophularineæ, others to Gesneraceæ. In reality, it was a solanaceous plant belonging to the tribe Salpiglossidæ. The examiner very kindly pointed out a character by which the plant could be separated from Scrophularineæ so similar in structure, and that was by the position in the corolla-tube of the stamens! There was also another character, the examiner added, by which the correct order could be ascertained, namely, by the *anatomical structure of the stem!*

"I certainly think that those candidates who have striven hard to secure first-class passes, and have been awarded seconds, have a legitimate cause for complaint, if their position has been at all affected by their inability to get right a plant of such uncertain affinities as that given on May 31 last."

Poor students! We heartily sympathise with you. It may be some little consolation to "the majority who referred it to Scrophularineæ" to know that they are in the same boat with some of the highest authorities on systematic botany, including the illustrious Bentham, who, in the greatest work on systematic botany in existence, De Candolle's "Prodromus systematis naturalis regni Vegetabilis," includes the tribe in Scrophularineæ, while in a work of almost equal importance, in which he was associated with Sir Joseph Hooker, the classic "Genera Plantarum," they will find the following note (vol. ii., p. 882): "The tribe Salpiglossidæ, by its didynamous stamens, with or without a fifth smaller one, often straight embryo and other characters, comes very near several Scrophularineæ, and is included among them by very many authorities." The authors, however, decided to keep it in Solanaceæ. *Hinc illæ lachrymæ!*

The Teaching of Systematic Botany.

Sir,—Will you allow me, in reference to the Note and Comment in the last number of Natural Science, to make a protest against the method in which candidates' knowledge of systematic botany is tested at the Science and Art Department's examination? It is practically impossible to set a plant which shall be equally fair to the candidates in all parts of the British Isles, and at the same time sufficiently

rare to be any test of a student's knowledge. Nevertheless, often the only opportunity given to a candidate to show acquaintance with the systematic part of the subject is in the determination of one plant. The species may be well known to all students in one part of the country, and may be very scarce or altogether absent in another; and thus chance is an important factor in the results. This might easily be to some extent avoided, if one or two questions were asked in the written part of the examination upon the principles of systematic botany, and on the classification and affinities of certain orders.

Another subject upon which an occasional question might well be asked, is the rules of nomenclature. Not one in a dozen of amateur or morphological botanists understands these rules; without some knowledge of them, the frequent changes of name are unintelligible, and botanists are using a scientific instrument which they do not understand. If this were done, systematic botany might not be so systematically neglected in England as is now the case.

August 15, 1895. A. R. F.

ERRATUM.

P. 117, line 23, for *Gymnurus* read *Gymnetrus*.

NOTICE.

TO CONTRIBUTORS.—*All communications to be addressed to the* EDITOR *of* NATURAL SCIENCE, *at* 22, ST. ANDREW STREET, HOLBORN CIRCUS, LONDON, E.C. *Correspondence and notes intended for any particular month should be sent in not later than the* 10*th of the preceding month.*

TO THE TRADE.—NATURAL SCIENCE *is published on the* 25*th of each month; all advertisements should be in the Publishers' hands not later than the* 20*th.*